ELECTRICAL REVIEW
AND
WESTERN ELECTRICIAN

VOL. LV, NO. 2. CHICAGO, SATURDAY, JULY 10, 1909. ISSUED WEEKLY

BY THE
ELECTRICAL REVIEW PUBLISHING COMPANY.
CHARLES W. PRICE, President.
H. S. TUTHILL, Secretary. PHILIP S. DODD, Manager.
C. W. FORBRICH, Assistant Treasurer.

PUBLICATION OFFICE: 204 DEARBORN STREET, CHICAGO.

EASTERN DEPARTMENT . . . . . 13 Park Row, New York.
E. E. Wood.
EUROPEAN OFFICE . . . . . 42 Old Broad Street, London, E. C.
Henry W. Hall.

A. A. GRAY, Managing Editor.

The present publication comprises: ELECTRICAL REVIEW, VOL. LV, No. 2; WESTERN ELECTRICIAN, VOL. XLV, No. 2.

SUBSCRIPTIONS.

One Year, United States	$3.00
One Year, Canada	4.00
One Year, Foreign Countries	6.00
Single Copy, 10 cents. Back numbers, beyond one month, each	.25

Changes of address reaching this office later than Monday cannot be made until the issue next following.

Entered as second-class matter, November 7, 1908, at the Post Office at Chicago, Ill., under the Act of March 3, 1879.

CONTENTS.

EDITORIAL:
- The Convention of the American Institute of Electrical Engineers. 45
- Improving Old Waterpower Plants. 46
- The Power at Hale's Bar. 47

American Institute of Electrical Engineers' Convention—Complete Report of the Proceedings. 48
For Extra Subway Tracks. 60
Moving Platform Subway. 60
More Electrification. 60
Lighting Plant for Pennsylvania Terminals and Tunnels. 60
The Wetterhorn Cable Road of the Grindelwald Glacier, Switzerland. 61
Electrical Exports for May. 64
The New Point of View. 64
Chicago Electric Club. 65
Navy Department Supplies. 65
Technical Book Publishing Consolidation. 65
Electrical Notes from Great Britain. 66
High-Speed Conduit Construction. 68
Electric Locomotive Headlights. 69
Ohio Electric Light Association. 70
National Electrical Contractors' Association. 70
"Exide" Meeting at Dayton, Ohio. 70
Commonwealth Edison Company Submits Profit-Sharing Plan to Employes. 71
American Society of Engineering Contractors. 71
General Electric Increases Plant. 71
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE. 72
INDUSTRIAL SECTION:
- New Overload Inverse-Time-Limit Relay. 74
- The Paragon Ground Cone. 75
- New Cut-Outs for Arc-Lighting Service. 76
- A Simple Low-Tension Magneto. 76
- Recent Installations of Electric Mining Machinery. 76
- Electric Drive in Patternmaking. 77
- An Improved Metal-Clip Wood Cut-Out Box. 78
- Car Lighting with Opalux Reflectors. 78
- Electric Vehicle Reorganization. 78

Committees of the Underwriters' National Electric Association. 79
Convention of the American Street and Interurban Railway Association 79
Rockingham Power Company Sale. 79
CURRENT ELECTRICAL NEWS. 80
DIRECTORY OF ELECTRICAL AND ALLIED ENGINEERING AND SCIENTIFIC SOCIETIES. 87
RECORD OF ELECTRICAL PATENTS. 89

Copyright, 1909, by Electrical Review Publishing Co.

THE CONVENTION OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

One of the pleasantest and most profitable conventions of the year is that of the American Institute of Electrical Engineers. Relieved almost entirely of everything except the straightforward presentation of technical papers and with interest heightened by a frank spirit of cordiality and freemasonry, those participating look forward to and make ready for a thorough good time. The convention just held at Frontenac, N. Y., in the Thousand Islands, will be remembered as one of the best of a number of exceptionally valuable and interesting meetings. The selection of this famous summer resort as the place of meeting was indeed fortunate, and the weather conditions were such as to elicit the extreme of commendation.

The programme for the technical sessions called for the presentation of thirty-seven papers, and these were grouped so that the attention could be concentrated upon certain subjects and the discussions, if necessary, become extremely general. The programme was so arranged that there was ample time between sessions for recreation, and the boating, fishing, golf, tennis and baseball gave everyone an opportunity to indulge in his favorite pastime. President Ferguson is to be congratulated upon the excellent arrangements which his committees carried through and for his earnest effort and complete success in keeping the meeting up to its schedule and clearing away the large number of papers presented.

Notwithstanding the length of the technical programme and the wide variety of subjects covered, there was missing from the list a number of subjects, the absence of which was remarked upon. This lack takes on peculiar significance in view of the meeting of the sections committee and delegates from the university branches and local sections during the convention. As was pointed out by President Ferguson in his address at Atlantic City last year, there is urgent need for the Institute to encourage the formation of local sections and superintend the holding of joint meetings with other engineering bodies in the various large cities. It is also necessary, in the opinion of many members of the Institute, that action be taken very soon looking to the amalgamation of interests of all electrical engineers, no matter along what lines their studies and work may take them. By some it is considered that the establishment of technical sections will counteract the tendency toward the formation of organizations devoted to some particular branch of

electrical work. The American Institute of Electrical Engineers is the parent body to which all electrical engineers should subscribe, and it should be a matter of engineering recognition and engineering pride which should constrain every engineer to participate in its membership. Those who are gifted by intelligence, natural talents and personality to become leaders in their respective sections should bend every effort to inculcating the high aims of the Institute in the minds of young engineers and swell the membership with desirable accessions through the work of the local sections.

It would be impossible to make any extended analysis of the attention devoted to each of the papers, and it will suffice to say that the discussion was complete and the printed transactions will form a valuable addition to the literature of each subject. Discussion of the two papers by Percy A. Thomas, dealing with output and regulation in long-distance lines, and with calculation of the high-tension line, was particularly brilliant, and, as was pointed out by several of those present, these data will become classical in the study of these phenomena.

The last session was marked by several particularly happy incidents. In the desire of President Ferguson to group the educational papers together, the paper by Professor C. A. Adams was held over until just before adjournment. The spirit in which Professor Adams made his presentation at the end of the session elicited the hearty commendation of those present and brought out a splendid tribute from Dr. Steinmetz, who hailed Professor Adams as "the leading designing engineer of our American universities." This session also brought forth a stirring appeal from Dr. Steinmetz devoted to the broadening and improvement of entrance requirements for young men taking up the study of electrical engineering. As a fitting climax to so special an occasion the Board of Managers presented retiring President Ferguson with a gold medal, as a token of their appreciation of the work which he had conducted and of the indelible impress which his personality had made so consistently throughout his administration. The presentation of this medal brought every man to his feet with a generous and genuine outburst of applause, and after a few remarks by the recipient the convention closed under the most happy circumstances.

IMPROVING OLD WATERPOWER PLANTS.

One of the most noticeable characteristics of the average hydroelectric power plant is the permanence of the station design. The majority of steam-generating stations may be remodeled by merely tearing out old equipment and making a place for new machinery—at considerable cost, it is true, but without affecting conditions outside the station to any serious degree. In the hydraulic plant a radical change in the methods of equipment and generation is almost certain to require alterations in the forebay, penstocks, building, canal, and perhaps the dam construction. For this reason it is generally the case that when a hydroelectric station is first laid out the design remains substantially the same as long as the plant is capable of doing its work. The initial cost of the waterpower development is too great to permit anything but extensions to the plant along the original lines, or the impounding of additional reservoir capacity as the load grows.

In visiting stations of this kind in different parts of the country one is therefore bound to be impressed with the fixed character of the individual installations, and often a distinct feeling of disappointment strikes the engineer familiar with the most advanced work when he encounters plants in which all the canons of efficiency and progressive practice appear to be violated. Not seldom is there a mental reservation of sympathy for the operating superintendent or manager who has such an assortment of line shafts, belts, gears, cramped wheel pits, oddly mated generators and governors on his hands, all probably housed in a dingy old wooden frame structure, utterly unfit for the advanced requirements of the present-day station. The visiting engineer congratulates himself that the maintenance and handling of such a plant are not his to accomplish on a limited annual appropriation, and not infrequently goes away unconscious of the real economy of production which the station displays to its owners. For a man accustomed to the operating data of steam plants cannot easily appreciate the extremely favorable service conditions under which even an antiquated waterpower station usually runs in periods where the water supply is fairly dependable and in cases where the development cost was not excessive.

Efficiency in the use of water is clearly more desirable in a station where an opportunity for storage exists than in cases where the supply must be taken on the run, so to speak. What is more important is that the reliability of service shall be increased as the load connected with the plant grows, and that the labor costs in the established station shall be kept down. The trend of financially feasible improvements in these old stations is set toward the accomplishment of these results, where practice is enlightened. Among the betterments which may be considered are the more symmetrical organization of the mechanical and electrical equipment; the installation of a controlling switchboard or gallery at a strategic point; the standardization of mechanical parts and elimination of odd sizes in shafting, gears and belt drive; establishment of uniform methods of lubricating bearings; sectionalizing of the prime movers in groups; installing transparency signals at the various governors and wheel gates to co-ordinate the handling of units from the switchboard and centralize the responsibility for the service rendered; removal of partitions to allow for the installation of more complete crane facilities; labeling of the internal wiring; replacement of antiquated switching apparatus by modern equipment; sectionalization of busbars and establishment of more positive methods of routine operation and inspection. Sometimes the re-wiring of the station lighting circuits and the better selection of lamps for improved locations will raise the efficiency of the station service as a whole. Multiplication of forms in apparatus accomplishing a common purpose is un-

desirable, and sometimes a slightly larger investment in the capacity of initial equipment will enable operation to be carried on with fewer spare parts and an increase of interchangeability that may be worth hundreds of dollars in an emergency. It is a revelation how cost of generation and reliability of service can be kept on a proper basis in some of these long-used stations, where conditions have been overcome along the lines above suggested.

THE POWER AT HALE'S BAR.

At Chattanooga the Tennessee River turns from its course down the Appalachian Valley and winds its way for nearly forty miles between the Cumberland Mountains, that rise 1,000 to 1,500 feet above its surface.

In this "Mountain Section" the Tennessee falls thirty-four feet along several series of rapids, at times of low water, and forty-seven feet when the river is in flood. The increase of fall in high water results from the narrow channel, often no more than 1,000 feet wide between the mountains, which sets back the river to a point above Chattanooga as the volume of discharge increases, and has a velocity of as much as fifteen feet per second at some points.

During the period since 1830 the National Government has made minor improvements in the channel along the "Mountain Section" of the Tennessee, and is said to have spent some $150,000 for this purpose.

Finally, in 1900, the government engineers reported on a system of slack-water navigation for this Mountain Section, and it was proposed to construct a dam at the "Skillet" that would set back the water to Chattanooga, and would give a channel five feet deep at low water. At the dam there was to be a single lock for the transfer of boats over the fall of about twenty-five feet, and the estimated cost of the dam and lock was $1,000,000.

Acts of Congress, in 1904 and 1905, authorized the Secretary of War to contract with persons who might wish to build the desired lock and dam, and accept the resulting water power as their compensation, and a corporation was organized for this purpose and has nearly completed the work, including a hydroelectric plant of about 50,000 horsepower. It was found that the location of the dam at Hale's Bar, thirty-three miles down stream from Chattanooga, would give a natural fall five feet greater than that at the "Skillet," which is only sixteen miles below the city, and that the loss of head at times of high water would be less at the lower point.

Hale's Bar was accordingly selected for the site of the dam, lock and electric plant, and in this way a normal water head of 36.5 feet was secured, with a storage area extending thirty-three miles up river to Chattanooga. The dam is of cyclopean rubble masonry, 1,200 feet long and about forty-two to sixty-two feet above the bedrock of the river.

Adjoining one end of the dam and in line with it is the concrete power and transformer house, some 300 feet long, and then comes an earth embankment with concrete corewall that runs some 700 feet to the bluff. The other end of the dam is the site of the lock, through which boats with an aggregate length of 300 feet, drawing six feet of water and fifty-nine feet wide, may pass at one time.

In the power house the design calls for fourteen vertical electric generators with a total capacity of about 50,000 horsepower, each generator being mounted at the top of a shaft that carries three turbine wheels. When there is a normal flow of water in the river only two wheels per generator will be used, but when the river is in flood water will be admitted to the third wheel so as to deliver a constant power with the reduced head.

With its total drainage area of 43,897 square miles, and a discharge of 11,000 cubic feet per second as a minimum at Paducah, Ky., where it joins the Ohio, the Tennessee must be classed with the great rivers of the United States. The Ohio is generally regarded as one of our great rivers, but it does not surpass the Tennessee in either high or low water discharge at Paducah.

At Chattanooga the drainage area of the Tennessee River is 21,418 square miles, and this city is 452 miles from the mouth of the river on the Ohio. Hale's Bar, thirty-three miles below Chattanooga, of course, has a little greater drainage area and discharge than that city.

At times of low water, the head of 36.5 feet maintained by the dam can be increased to 39.5 feet by the use of flashboards. With this head of 39.5 feet and the ordinary minimum flow of 5,000 cubic feet of water per second in the river at Hale's Bar the gross water horsepower amounts to 22,407, from which all wheel, generator and transmission losses must, of course, be deducted to determine the power that may be delivered to consumers. No doubt the average flow of about 40,000 cubic feet of water per second in the river at Hale's Bar, and the storage area along thirty-three miles of its length to Chattanooga, warrant a power-house equipment for much more than the minimum flow of 5,000 cubic feet per second, and this is indicated by the installation of about 50,000 horsepower.

Probably the most unique and certainly one of the most valuable features of this notable development is its storage area along thirty-three miles or more of the river. Taking the length of storage at thirty-three miles and its average width as 1,000 feet, though it is probably more, gives a storage area of 174,240,000 square feet. For each foot of depth over this area that may be treated as storage without too great reduction of the operating head the stored water is 174,240,000 cubic feet, representing the minimum flow of 5,000 cubic feet per second in the river during 9.6 hours. At the minimum rate of discharge the entire night flow of the river may be stored and then used during the working hours of the following day with a reduction of a little more than one foot of the head on the turbine wheels.

The hydroelectric plant at Hale's Bar appears to be the largest in point of capacity of any in the Central West, and is perhaps larger than any such plant in the country, aside from those at Niagara Falls.

American Institute of Electrical Engineers.

Twenty-sixth Annual Convention, Hotel Frontenac, Frontenac, N. Y., June 28 to July 1.

One of the most enthusiastic and altogether satisfactory conventions ever held by the American Institute of Engineers was that convened at the Frontenac Hotel, Frontenac, N. Y., June 28 to July 1. In point of attendance the convention was not quite so large as in some previous years, but whatever lack there was in numbers was made up in good-fellowship and fine spirit of cordiality, and in the excellent discussion which attended the technical sessions. The meetings and papers committee had made a careful grouping of the technical papers, and the earnest work of President Ferguson kept the meeting up to its schedule and brought about a very complete and satisfactory treatment of all the important presentations.

The convention committees set a mark for future conventions to aspire to in the thoroughness with which they had made their plans for the entertainment and edification of the visitors. The Thousand Islands, a famous resort at any time, were dressed in their best holiday attire and the weather was all that could be wished for. The golf tournaments, the special matches, the fishing and boating, tennis and baseball afforded recreation for those of widely varying inclination. It is easy to say that never before have the entertainment features been so thoroughly enjoyed as during the session just passed.

A number of those attending the convention had come down to Thousand Islands over Saturday and Sunday, and fully seventy-five per cent of those attending were ready for the first session, which was called to order on Monday morning shortly after ten o'clock.

President Ferguson took for the topic of his address the subject of "The Centralization of Power Supply." Mr. Ferguson said that the tendency today was toward the consolidation of large interests, that it was the age of consolidation, the economies secured through the aggregations of small units were being appreciated, and these combinations were resulting in material benefit to the whole people. In the electrical field, consolidation had been backward, but the awakening was now at hand; and the investor was looking upon electrical securities with greater favor, for these securities, now that centralization of power supply had become an economic entity, were being marketed more easily and upon better terms. Centralization of power supply means a better load factor and a better relation between fixed charges and operating costs; improvement of the load factor means greater earnings, and this can be accomplished most surely by combining all classes of service with the maximum loads coming at different periods. Centralization brings cleanliness and improves civic conditions. Chicago, because of its strategic position, is destined to become one of the world's greatest cities, and the possibility of its power development seems almost boundless. Centralization there is already well advanced. Industrial-power business has not been properly developed. By combining all of the electrical systems in cities within a radius of thirty or forty miles great economies could be effected. The naturally monopolistic character of electric companies is being recognized and monopoly privileges under proper regulation are being advocated, and the legal way is being made to establish the monopolies. Continuing, Mr. Ferguson said:

"It has seemed to me that a condition of such transcendent importance to the electrical profession should receive liberal attention and consideration from our Institute. We, as an organization, have a large part to play in the development of the art of electrical application as well as in electrical science. . . . The progressive work of the electrical engineer will determine with what success we can reach out into these larger fields. The mechanical engineer has given us a steam turbine of greatly improved economy; it is for us to improve still more the method of transmission and conversion and the application of electricity in the arts. It is for the commercial electrical engineer (which really includes nearly all of us) to educate the layman and particularly the power user to an appreciation of the superiority and desirability of electric service and to emphasize the material and ethical advantages to a community of centralized power production.

"It is for the technical electrical engineer to furnish him with the sinews of war, with the ammunition to conquer in the fields where waste, where useless dissipation of energy prevails. We should bend every effort to advance the cause of centralization with its resultant economic gains. Those connected with the manufacturing interests especially should not tolerate for an instant a selfish backward step within their fold.

"As we meet here in convention to gain a broader knowledge and to discuss our special problems let us think of those opportunities which our profession affords in this grand movement for world betterment, this guiding of the forces so that Nature's bounty to man will bring to him the highest and greatest good. The thought carries with it inspiration and enthusiasm and a determination to do our part, individually and collectively, in the successful upbuilding of an industry which means so much to the economic development of the country's resources."

At the close of his address Mr. Ferguson said that it gave him great pleasure to call upon the popular choice for president of the Institute, Lewis B. Stillwell, whose labors both for the Institute and in the profession were so well known that an introduction was unnecessary. He appointed C. W. Stone and Paul M. Lincoln escorts to bring Mr. Stillwell to the chair.

Mr. Stillwell said that the management of the Institute was wisely in the hands of a board of managers, whose terms of office were so arranged that continuity and coherence of efforts would be secured. The fact that the constitution had been amended no less than six times within the last twenty-six years indicated that the Institute was awake and progressive. Never before did the scientific man have so great an opportunity of impressing his usefulness upon the people at large, and no body of men had so great an opportunity of performing valuable service as the electrical engineers. There were many problems to be solved and the methods of procedure must be along scientific and engineering lines. Every effort should be made to bring the members of the Institute to a plane of culture and high standing such as has heretofore never been attained. Another matter which the members should give attention to was the the work of the committee on engineering education. Mr. Stillwell considered that we are handicapped by lack of breadth in our preliminary education. No small proportion of the time of the engineers responsible for constructive work is used up in making a proper presentation of his ideas to those who make the decisions as to whether the work shall be undertaken, and the young engineer, in addition to his technical training, should receive as much instruction as possible in the humanities and tributary sciences as will tend to make his lines of reasoning and forms of expression more comprehensive.

The first paper, entitled "The Convection of Heat from Small Copper Wires," by A. E. Kennelly, C. A. Wright and J. S. Van Bylevelt, was read by Dr. Kennelly.

The object of this paper is to describe a research made on the convective loss of heat from small copper wires, of less than 0.7 millimetre or 27.5 mils diameter, and to present some quantitative results arrived at from the observations. Convection was arbitrarily divided into two classes: (1) Free convection, when the wire is supported in free, still air; (2) forced convection, when the wire and the surrounding air are in relative motion one to the other. The experimental methods employed in this research were: (1) To vary the atmospheric pressure surrounding the test wire, under conditions of free convection, and to measure the change of electric power required to maintain the wire at constant temperature elevation; (2) to subject a wire to varying wind velocity, under conditions of forced convection, and to measure the change of electric power required to maintain the wire at constant temperature elevation. For the first, a short length of the copper wire under test was supported horizontally in an airtight tank and supplied with a steady current from a storage battery. By ad-

justing the current strength, the wire was kept at constant resistance and, therefore, at constant temperature. The pressure of air in the tank was varied by means of an air pump. For the second test, in order to measure forced convection, the test wire was mounted between the prongs of a long fork, which was fastened at right angles to a shaft driven by a motor at a regulated speed. The test wire was thus forced to move transversely through the air at a known velocity. Electric connection was maintained with the moving wire through pairs of slip rings and brushes, one pair of slip rings carrying the testing current through the moving wire, while another pair served to maintain pressure connections with taps near the ends of the wire. The wire was maintained at a constant temperature by keeping its resistance constant. From the experiments the following summaries were deduced: (1) Free convection in a tank—At constant standard air pressure of one atmosphere, the linear convection was proportional to the temperature elevation of the wire, and was in the neighborhood of 6,000 abwatts (6×10^{-4} watt) per linear centimetre per degree centigrade, and, to a first approximation, independent of the size of the wire, although increasing slowly with the diameter. Under varying atmospheric pressure, the linear convection increased with the pressure, substantially according to an exponential law, the exponent being the same for the same wire at different temperature elevations, but with different wires increasing slowly with the diameter of the wire. The current strength required to maintain a wire at constant temperature under free convection in varying atmospheric pressure, followed an exponent of the pressure, the exponent being the same for different temperature elevations (up to 180 degrees centigrade) of the same wire, but increasing slowly with the diameter of the wire. (2) Forced convection—The linear convection was proportional to the temperature elevation of the wire at the same wind velocity. The linear convection, at any single wind velocity between 200 and 2,000 centimetres per second, increased with the size of wire and, as a first approximation, in direct proportion to the wire diameter. Under varying wind velocities, within the same range, the linear convection increased as the square root of the velocity. At lower velocities the linear convection was greater than this, owing apparently to the presence of free convection in air not moved by an external force. The linear convection from a wire under a wind velocity of 2,000 centimetres per second was nine times that of the wire when at rest.

The discussion was opened by Prof. V. Karapetoff, who said that Dr. Kennelly should receive all credit for his ingenious system of notation, which had been found to be of great value in technical work. He did not understand, however, the reason for using this notation in the present paper, as the measurements had been made with the standard units, and in this presentation had been converted to the absolute system rather to the confusion of the engineer. He also asked whether the use of the corrective term in measuring the power expended did not introduce considerable difficulties in plotting the results on logarithmic paper.

Dr. Charles P. Steinmetz said that with a little experience and by utilizing well-known mathematical laws, the annoying feature of the corrective factor could be eliminated and logarithmic paper could be used in plotting the results.

Charles F. Scott expressed the opinion that the use of this nomenclature complicated the understanding of this excellent paper. He also raised the question whether it could be stated that the velocity of the air passing the heated wire was ever at zero, and suggested that it be considered that there was always a relative velocity between the wire and the surrounding air. He suggested rotating the wire at a certain speed so that there would always be a basis of virtual velocity when the wire would always be surrounded by heated air at a certain velocity.

Paul M. Lincoln said that Dr. Kennelly had contributed a very valuable paper and that it answered one of the first questions that a designer had to reckon with concerning the rate of radiation of heat from a conductor and the law of the relations which were effected by forced ventilation.

Dr. Kennelly in replying to the discussion said that the paper was almost purely a physical one and that it was thought better and safer to keep to the absolute system. Mr. Scott's suggestion in regard to the virtual velocity of the air was pertinent, but the investigators did not feel they were justified in stating the virtual velocity of air moving about a still wire. Possibly this statement was correct, and he would like to see someone demonstrate it.

The paper entitled "An Alternator for 100,000 Cycles," by E. F. W. Alexanderson, was read by the author.

This paper describes an inductor alternator built for Professor Fessenden's wireless telegraphy work. The machine was the first high frequency generator to have a commercial rating as high as two kilowatts. Its speed is 20,000 revolutions per minute. Both the field and the armature are stationary. The latter has 600 slots with one conductor per slot. The rotating field mass is a disk with 300 projections on each side, one-eighth inch apart, thus corresponding to 600 poles in a machine of the ordinary alternate-pole type. The output varies largely with the air-gap clearance, which is adjustable from about 0.015 to 0.004 inch. The shaft is flexible; it has its largest diameter, one-and-one-fourth inches, at the center and at the ends the diameter is five-eighths inch. The machine is geared to its driver through a gear ratio of ten to one. The diameter of the disk is one foot and its peripheral speed is 700 miles per hour. It is designed to have uniform stresses in all its parts. To overcome air friction it was found necessary to have non-magnetic fillers between the projections on the disk; these gave it a smooth surface. The generator has four bearings. The middle ones have one-sixty-fourth inch clearance and are more for steadying the revolving shaft in starting; at full speed they are free from the shaft. The outer bearings carry the weight of the revolving parts and are lubricated by oil circulated by a pump. At the close of the paper the electrical characteristics of the machine are discussed and illustrated. The no-load voltage is 110 and the short-circuit current is twenty amperes. The maximum continuous output is thirty amperes at seventy volts. Under the author's directions a machine giving thirty-five kilowatts at 50,000 cycles is now being built.

J. C. Lincoln asked why the revolving portion was made so small. He suggested that if the diameter of the disk were increased it could withstand higher centrifugal strains and improve the mechanical features of the machine.

D. B. Rushmore said that the new construction was similar in many respects to the old inductor alternator, which more than held its own until lower frequencies were demanded in commercial machines. The characteristics of the newer machine were similar to the old inductor and the data realized could possibly be used to advantage in connection with the older form of construction. The subject of the critical speed involved also was of interest and was in line with modern work which indicated a tendency to use velocities limited only by the strength of material.

Replying to the discussion, Mr. Alexanderson said that the choice of the diameter of the revolving disk was purely a natural one in an experimental case. The machine now being built for an output of thirty-five kilowatts has a diameter of three feet in the rotating member. Replying to a question with regard to the effect of the alinement of the shaft he said that this had apparently nothing whatever to do with the speed. The point was also raised whether the chrome-nickel could withstand a tensile strain of 200,000 pounds per square inch. Mr. Alexanderson said that he had received assurances that the material could be depended upon and that it was expected that it would be cut and turned before it was hardened by a special oil hardening process.

The paper entitled "Method of Testing Transformer Core Losses Giving Sine-Wave Results on Commercial Circuits" was read by L. W. Chubb.

The author points out in this paper that the core loss in a transformer is not ordinarily the same that it would be with a sine-wave electromotive-force on account of the common variation of the wave shape from the ideal sine form. Since, for the sake of comparison, it is necessary to determine the core losses with sine-wave electromotive-forces, and since the equivalent conditions can be produced by a certain change of voltage, the author recommends the use of an instrument which will indicate exactly when the voltage of the circuit has been adjusted so that the core loss with the particular wave shape of that circuit is equivalent to what it would be with a pure sine wave. Although the standardization rules for a sine wave allow a deviation from the equivalent sine of ten per cent of the maximum ordinate, the use of such a nominal sine is not correct in core-loss determinations on account of the large percentage of error in the results that may result in comparison that would be obtained from an equivalent sine. The eddy-current loss component of the core loss depends upon the root-mean-square value of the induced voltage, while the hysteresis component depends upon the average values of this voltage. With the use of an ordinary voltmeter giving root-mean-square values the eddy-current losses will be correct, but the hysteresis loss and the sine value may be high or low, depending on the form factor of the voltage wave. If an average voltage rating

were taken the hysteresis loss would be correct, but the eddy-current loss would be either high or low. In the instrument described, which is termed by the author an iron-loss voltmeter, the readings are such a function of the average and effective voltages, that when it reads a normal voltage in the transformer, the error in the eddy-current loss is equal and opposite to the error in the hysteresis loss, thus giving the correct total core loss. The instrument consists of a ring-shaped core of laminated steel about which is a winding which has a series coil of a wattmeter in its circuit. A shunt circuit connected to the same terminals contains the movable coil of the wattmeter movement, a compensating coil around the stationary series coil and a non-inductive resistance. The indications of the wattmeter correspond to the total input to the instrument, which is equivalent to the iron losses in the laminated ring and the copper losses in the instrument. The sum of these losses is dependent both upon the average value and the effective value of the terminal voltage. The instrument is calibrated so that its indications agree with the readings of a voltmeter on a circuit having a pure sine voltage wave. In using the instrument the voltage in the circuit is regulated by either resistance or inductance until the iron-loss voltmeter indicates the normal voltage of the circuit. At this point the core loss of the transformer is measured on a wattmeter. The accuracy of the instrument is in general within one per cent and in extreme cases within two per cent. The author also describes a method of correcting the form factor to eliminate even the smallest errors. The paper is concluded by giving some specimen test results in which the iron-loss voltmeter was used.

Prof. Frederick Bedell said that if the permanency and calibration of the instrument could be relied upon it would prove of great value.

Dr. Steinmetz said that the use of the instrument involved a definition of the form factor as the ratio of effective to mean value. This gives a value for the sine wave of 1.1. This was unfortunate, as the standard sine wave should have a value of unity. He would suggest, however, that the definition should be given as the ratio of the effective to the mean in the actual wave to the ratio of the effective to the mean in the pure sine wave.

M. G. Lloyd stated that the instrument should prove of great value to manufacturers who did not have laboratory facilities, as it would enable them to participate in bidding on contracts for supplies for the Navy Department, the specifications in many cases calling for the form of the wave form in certain lines of material. He questioned whether the instrument could be used to cover a variety of materials used in transformer construction, and he considered also the excessive weight of the instrument as a handicap, as it did not allow it to be classed as a portable machine.

Charles F. Scott said the machine was essentially a practical instrument; under fairly wide variations its readings were substantially correct. To get at the real value of the instrument one must consider the instruments and the series of checks it displaces. It has become of great value in factory testing.

Dr. Steinmetz explained a method whereby a sine wave might be secured, no matter how great the distortion in the main circuit. If in one leg of the circuit two large reactances were placed in series and a condenser put in shunt across the line, one terminal of the condenser being connected at a point between the two reactances, an ammeter placed across the line, one terminal being connected beyond the second reactance, would show but a small distortion. Taps taken off from a coil across the circuit, if the current flow in the tapped portion is small compared to the whole current flowing, would give a sine wave as desired.

The paper entitled, "Testing of Transformer Steel," by M. G. Lloyd and J. V. S. Fisher, was read by Dr. Lloyd.

At the beginning of this paper the authors discussed the conditions that should be realized in the measurement of the losses occurring in sheet iron and steel subject to alternating magnetization. A description of the method made use of by the Bureau of Standards, which is a modification of the Epstein method, is then given. In this modified method the sample to be tested is stamped into strips about ten by two inches. These are assembled into four bundles, the sheets of which are separated by strips of pressed board, and each bundle is inserted into a solenoid. The four corners are joined by special corner pieces so as to produce a substantially perfect, rectangular magnetic path. Each solenoid has two secondary windings above which are wound the primary exciting winding. This method is said to be the closest approach to the ideal conditions for testing such samples. The accuracy attained is within one per cent, and the material consumed is only about four pounds. The results of various numerous tests are given. These show a very wide range in the quality of transformer steel in general use, the quality not seeming to have any direct connection with the price. Among the samples tested were a number of foreign specimens of ordinary and of silicon steel for comparison with the American products. By making measurements at two frequencies, viz., thirty and sixty cycles, the eddy current and hysteresis losses were separated and a study made of the variation of each with flux density. The values of the hysteretic constant and the total loss in watts per pound at sixty cycles and 10,000 gausses were obtained and tabulated. The effects of artificial aging were shown to depend upon the flux density selected for test, the hysteresis increasing more for 5,000 than for 10,000 gausses. Therefore, it is recommended that such tests should be made at the particular density to be used in the transformer. In silicon steels the aging was found to be practically negligible.

L. T. Robinson asked whether the method proposed by Dr. Lloyd was a workshop proposition, and why was not the Epstein method satisfactory. Has the method suggested by Dr. Lloyd been demonstrated to be identical with results found with ballistic methods?

Professor Karapetoff said that the method described by Dr. Lloyd had some advantage, inasmuch as putting the strips on edge were concerned, but there was a disadvantage in using so many corner pieces. He suggested using longer strips and bending them, thus reducing the number of joints.

Andrew Pinkerton said that there was little use in making tests of sheets from small sections or strips.

Dr. Clayton L. Sharp said that Dr. Epstein had stated to him that tests made on small strips of iron had no value whatever as indicating the characteristics of larger pieces of material.

MONDAY AFTERNOON SESSION.

The Monday afternoon session was called to order at 2:15 with the closing of the discussion of the previous paper by Dr. Lloyd.

The paper entitled "A Sketch of the Theory of the Adjustable Speed, Single-Phase, Shunt Induction Motor" was read by F. Creedy.

The author at first describes the three fundamental ways in which speed variation in this type of motor is attained. All are modifications of the Atkinson commutator motor, in which the rotor has four brushes, or sets of brushes, one or both pairs of which may be short-circuited. These three methods are: (1) Variable voltage control; this is accomplished by feeding an extra voltage from the line, through a transformer preferably, to what may be regarded as the armature circuit of the motor's rotor. (2) Adjustable field excitation; this may be done by inserting an inductance or capacity in the rotor circuit at right angles to the one above; an inductance raises the speed and a capacity lowers it. (3) A modification of the previous method is to place a coil on the stator, with its axis parallel to the "field" axis and connected in series with the field brushes; this will weaken or strengthen the rotor ampere turns, depending on its connection. Other methods are combinations or modifications of these. In order to discuss the relative merits of the three leading methods, the theory of each is considered by aid of the circle diagram. This shows that the shunt motor excels both the regular single-phase and polyphase motors enormously in regard to overload capacity and power factor; in fact, it is closely analogous to the direct-current motor in that the output is not limited by the breakdown point, but by heating and sparking. The author suggests that a salient pole construction might be used. In general, the first method is suitable for increased speed only and is not adapted for speeds below synchronism. The second method gives conditions quite similar to those of the ordinary single-phase induction motor; it works best with the motor compensated; the use of capacity is not practicable, however. The third method is adapted to speed reductions only, and is limited practically to a twenty per cent reduction below synchronism. After discussing phase compensation and commutation, the paper concludes by giving some experimental results attained by the author, F. Punga and Dr. A. Fraenckel, with some motors of this general type.

The next paper, entitled "Repulsion Motor with Variable-Speed Shunt Characteristics," was read by E. F. W. Alexanderson.

The object of this paper was an investigation into the possibilities of an alternating-current motor with adjustable speed to replace the direct-current shunt motor, which is at present the only one on the market to fulfill this requirement. The author commenced by presenting a theory of the alternating-current machine in such a way as to indicate the possibilities of developing a motor with the required characteristics. He then proceeded to demonstrate cases of a shunt repulsion motor with speed regulation by armature control

and by field control. The first is effected by introducing a voltage from the outside into either the circuit of the main brushes or the circuit of the exciting brushes. This voltage may be either positive or negative, and consequently the speed may be regulated below synchronous speed as well as above. In the second method, the short-circuit is maintained on the main brushes, while an external voltage is impressed upon the exciting brushes. In order to make the impressed voltage effective for speed variation, it should be in phase with the voltage of alternation and the voltage of rotation of the same circuit. The speed variation by armature control is particularly applicable to those cases in which the torque increases with the speed, and field control to those cases in which the torque decreases with the speed. With armature control a speed variation of three to one can be obtained; with field control, one-and-one-half to one. The author, in conclusion, stated as his impression that the single-phase shunt motor will be preferred on account of the greater simplicity of control.

Discussing Mr. Creedy's paper, Mr. Alexanderson explained various methods of affecting speed variations in single-phase motors. He said exceptions should be taken to Mr. Creedy's statement that the speed could not be conveniently lowered below synchronism. It would also be of interest to owners of single-phase motors to know that a complementary device would be available giving to constant-speed motors the adjustable shunt features.

The paper entitled "Reduction in Capacity of Polyphase Motors Due to Unbalancing in Voltage," by S. B. Charters, Jr., and W. A. Hillebrand, was read by Mr. Charters.

The authors of this paper have made a study of the effect upon the capacity of a polyphase motor of unbalance in the voltage and also of phase angle between the various phases of the motor. A series of tests was made in which voltage unbalance and phase displacement were separated in a number of cases and in others the effects were combined. The tests were made upon several two and three-phase induction motors of moderate size. In all cases it was found that a marked decrease in capacity resulted from either of these causes. In several instances the capacity was reduced to fifty per cent by a voltage unbalance of about twelve per cent between the phases. The influence of transformer regulation is to slightly mimimize the effect of the unbalancing. Some tests were also made with a synchronous motor. In this the results were similar to those given by the induction motors except that the combined effect of voltage and phase angle unbalance, instead of being greater than the sum of the effects, as was the case with the induction motor, was found to be somewhat less than this sum, due to a neutralizing tendency of these effects. The general conclusions reached by the author are: (1) Unbalancing of voltage and shift of phase tend to cause serious overheating in polyphase motors. (2) Where it is possible to separate the effects due to phase shift and voltage unbalance, the former is found to be of relatively more importance. (3) The reduction in capacity due to either phase shift or voltage unbalance varies with the cause approximately according to a straight-line law. (4) In the induction motor the existence of phase shift and voltage unbalance causes a worse performance than would be expected from either irregularity alone, whereas in the synchronous motor the reverse is true. (5) The performance of an induction motor supplied from an unbalanced circuit is materially affected by designs. (6) The commonly accepted statement that the torque of an induction motor varies with the square of the voltage should be changed to read "varies with the voltage," in order to make it more consistent with conditions found in ordinary operation.

A communication from R. E. Hellmund was read. Mr. Hellmund stated that it had been his experience that the interchange of heat between the various stator parts is comparatively good. The final temperature of iron and coils is as a rule pretty much alike, no matter how the losses are distributed between the iron and copper. The only remedy that may be applied to unbalanced circuits in the motors is to improve the line construction.

A communication from I. E. Hanssen said that all conductors should be arranged so as to prevent the unbalancing of circuits. All conductors should be arranged as nearly symmetrical as possible and unbalanced transformer connections, such as open delta or two-phase-three-phase, should be avoided wherever possible.

J. B. Parker said that the commercial features involved in unbalance were important. Where long-distance power transmission is involved the danger of unbalance is great. Where central-station companies supply power and lighting circuits there is also considerable danger of unbalance. In many cases these companies penalize users for bringing about unbalanced conditions, and they are also giving some customers a better rate for using current so as to maintain a better load factor. He also said there was strong reason why a maximum-demand current meter rather than a maximum wattmeter should be used, as with the latter there was still opportunity for considerable unbalancing of circuits.

Dr. Steinmetz said that he did not agree with the statement given by the authors that the torque varied directly as the voltage. At constant voltage the torque varied directly with the load. In order to understand the situation correctly, it must be stated what torque is meant. One condition of torque is when the motor falls out of step and stands still, the other is the maximum torque when the motor will pull continuously with constant heating.

C. F. Scott said that the safe capacity of the motor does not always depend upon its heating, as its limit of safe operation may lie in some other direction. An unbalanced single-phase load is helped back to balance in some cases because other variations may compensate from one circuit to the other. The conclusions arrived at by the authors do not permit of indiscriminate application.

Mr. Charters stated that the torque in most cases will vary almost as a linear function. He also cited an instance of a three-phase plant in which some of the motors, when standing idle, would not start up because of the inability to effect proper regulation. When other motors were operating they would tend to compensate, and no difficulty would be encountered in starting the larger motors.

The paper entitled "The Current Locus of the Single-Phase Induction Motor" was read by A. S. Langsdorf.

The author commenced by deprecating the general use of Ferrari's expedient of resolving the impressed alternating magnetic field into forwardly and backwardly rotating components, in the theory of the single-phase induction motor. Within the last few years the tendency has been to go back to first principles, and several valuable contributions have appeared, notably those of Fynn and McAllister. The author's treatment is based largely on the theory advanced by Fynn in his several publications. The subject was taken up under three successive divisions: General principles and vector diagram; mathematical treatment; experimental results. From the considerations involved it appears that statements to the effect that the current locus is a curve of higher order are in error. The locus is a true circle in spite of the complicated nature of the equivalent circuit, and it may be readily determined for any given motor by two simple measurements—primary current and power-factor with the rotor open-circuited, and the impedance voltage and power-factor with the rotor blocked and short-circuited.

This paper was discussed briefly by Professor Karapetoff, who thought that the substitution of the commutator in this instance was not necessary.

The paper entitled "The Multi-Speed Induction Motor," by H. G. Reist and H. Maxwell, was read by Mr. Reist.

In multispeed induction motors the different synchronous speeds are produced by changing the number of poles in the magnetic circuit. Secondary resistance may be used to vary the speed below each of the synchronous speeds. A change in the number of poles may be produced in any one of the following ways: *a* By the use of single magnetic and electric circuits, changing the number of poles by regrouping the coils. *b* By the use of a single magnetic circuit and independent electric circuits. *c* By means of separate magnetic and electric circuits. The paper proceeded to discuss each of these methods in detail. As a suggestion in the selection of the best type of motors for various conditions, the following conclusions were appended, subject to broad interpretation according to modifying circumstances: (1) For two speeds ratio two to one, use motor type *a*. (2) For two speeds having ratios other than two to one, use motor type *b*, except when the winding and insulation require too much space. (3) For three speeds, two having ratios two to one, the other intermediate, use type *b* with one winding connected as in *a*. (4) For four speeds, one one-half the highest speed, and the lowest speed one-half of the next highest speed, use type *b* with each winding such as is used in type *a*. (5) For two or more speeds close together, use type *c* concatenated motors. (6) Use concatenated motors when polar windings on the rotor are necessary with more than two speeds, or if the two speeds differ from two to one. (7) Use concatenated motors for high-voltage machines except when type *a* can be used.

This paper was discussed at some length by H. C. Specht. Mr. Specht's conclusion was that with cascade motors practically any set of speeds may be obtained, but that this is not the case with

the multi-speed motor. Even if the cost of cascade motors is higher, they can be recommended when simplicity and safety of control and operation are desired.

Dr. Steinmetz said that there was no gain with the cascade motor; rather there is a loss in having two structures instead of the single motor. For general stationary work the machine that changes the number of its poles is superior mechanically and electrically.

In closing the discussion Mr. Reist stated that the machine he described would cover any reasonable range of speeds.

The paper entitled "The Heating of Induction Motors," by A. Miller Gray, was passed over in the absence of the author.

TUESDAY MORNING'S SESSION.

The third session was called to order promptly at 10 o'clock Tuesday morning, and two papers were read by Percy H. Thomas. These were entitled respectively, "Output and Regulation in Long-Distance Lines" and "Calculation of the High-Tension Lines."

These papers provoked a brilliant discussion, which was opened by Thomas R. Rosebrugh and participated. in by Dr Kennelly, Professor Karapetoff, J. B. Taylor, D. C. Jackson, Dr. Steinmetz, P. M. Lincoln, R. D. Mershon, H. W. Fisher, J. B. Whitehead and Charles F. Scott.

The first paper treated of limitations of the power-transmission line as to distance, power and voltage, and its characteristics as to voltage variation, energy loss, and line output. The electrical action in the line was first discussed by reference to the "leading energy," or that flow of energy which is absorbed by the line capacity on rising voltage and is returned on falling voltage; and the "lagging energy," or that energy which is absorbed by the line inductance on rising current and returned on falling current. A table was given showing illustrative line adjustments with calculations, and among the several illustrative examples was the 700-mile transmission line of the Victoria Falls Power Company. The true energy loss in this line works out to 10.4 per cent, the drop in voltage 12.1 per cent, and the rise in voltage due to the effect of throwing off the load, twenty-two per cent, assuming that the synchronous machines at the load end supply no leading energy in the no-load condition or that they have dropped off the line. The power to be delivered at full load was assumed to be 40,000 kilowatts at 150,000 volts, and with a load power-factor of 0.85. The terminal apparatus for long-distance lines was fully considered, as much depends on the type and adjustment of this apparatus, generators, motors, and synchronous converters, in controlling the line voltage, energy loss and power-factor. In conclusion, some of the more important points were summarized as follows: To obtain the most economical transmission of power over a long-distance line, it is necessary to have balanced the leading and lagging energies of the line itself, and at the same time to have unity power-factor. To obtain satisfactory regulation, the leading current taken by the line at light loads should be fed mainly from the receiving end. Non-synchronous generators are suggested for the power house where it is desired to supply the leading energy for the line from the receiving end, which then becomes the controlling and operating point of the system. Constant voltage or suitable compounding should then be maintained at the receiving end and not at the generating end of the system, thus practically eliminating line voltage regulation as a disturbing factor.

The other paper discussed calculation of the high-tension line as relating to the important matters of regulation and energy line loss, and with special reference to the unusually long and high-power lines. For this purpose several new formulas suited for practical calculations are derived. There is derived a formula for calculating the true current, voltage, and power-factor at the generator end of a transmission line when the current, voltage and power-factor at the receiving end are known. For purposes of comparison an approximate formula is given, based on the much-used assumption that the line capacity is concentrated at the ends of the line. This is called the "split-capacity" formula in distinction from the "wave" formula, with the distributed capacity. The former is adapted to slide-rule work and the latter is exceptionally simple and can be used with a table of cosines and tangents.

Mr. Rosebrugh was of the opinion that the equations could be put in much simpler form, and Dr. Kennelly contended that the use of hyperbolic trigonometry was simpler and afforded a better opportunity for elucidating such complex mathematics as was involved in transmission-line calculations.

Professor Karapetoff said that the prophetic picture projected by Mr. Thomas was very important, as it would help greatly in preparing engineers for development work in the future. This paper, he said, would undoubtedly be considered a classic, and would be referred to by engineers in the days to come. It would be a matter of regret if the splendid works thus presented were not given expert mathematical revision to the end that some of the equations might be simplified and the method of procedure shortened.

Professor Jackson said that the tables available in hyperbolic trigonometry were not complete enough to be useful in computation, and Mr. Thomas was justified in sticking to circular functions. The paper was admirable in making such a good start toward a practical method of computation of power-transmission data.

The paper entitled "Even Harmonics in Alternating-Current Circuits" was read by J. B. Taylor.

The author commenced his paper by stating certain misconceptions concerning the omission of the second, fourth, sixth, etc., harmonics in the consideration of wave forms in alternating-current circuits. A number of oscillograph records showing current corresponding to simple sustained vowel sounds were given, demonstrating the even, as well as the odd, harmonics that telephone lines, transformers and receiving apparatus have to deal with. There is no difficulty in connecting standard generators in series or in parallel when the resulting wave form will have pronounced even harmonics. A typical example taken was a three-phase, high-tension transmission system with transformer neutrals grounded at both ends. Another was a single-phase railway with a ground at a substation and also at various cars along the line, while a neighboring direct-current traction system caused direct current to be shunted into the alternating-current system. An oscillogram showed a pronounced second harmonic in the transformer magnetizing current, due to direct current in the windings. The author proposed the use of counter-electromotive-force cells, similar to storage batteries, but with plates unformed, in order to check leakage direct currents, but he had not yet seen a case where the magnitude of these currents warranted such a proceeding.

This paper was discussed by Frederick Bedell, Professor Karapetoff, C. F. Scott and Dr. Steinmetz.

Professor Karapetoff said that the reason why even harmonics do not appear in commercial machines is because in nearly all cases they have been mutually canceled.

Dr. Steinmetz said that even harmonics were just as frequent as odd harmonics in the transient phenomena of electrical circuits; that there is no physical reason why even harmonics should not exist, particularly in the upper harmonics.

The paper entitled "The Resistance and Reactance of Armored Cables" was read by J. B. Whitehead.

In a recent single-phase railway installation it was deemed desirable to use armored cables in connection with a drawbridge. To ascertain whether the reactance and losses in the armor would be prohibitive, calculations and tests were made whose results are recorded in this paper. The tests were made with No. 0 B & S stranded single conductor, paper-insulated, lead-sheathed, jute-covered, iron-armored cables and similar cables that were copper-armored. The decrease in effective resistance and increase in effective reactance, with increasing separation, were noticeable at sixty cycles, but not important at twenty-five cycles. From these tests the following conclusions were drawn: (1) Theoretically the reactance of the usual type of single-conductor, iron-armored power cable may be from two to 4.5 times that of the unarmored cable, depending on the distance to the return conductor; the factor increases with decreasing distance. (2) In cables as manufactured the reactance is about seventy per cent of the maximum theoretical value. (3) The effective resistance as measured varies little with the distance to the return conductor and is about 1.6 and two times the dead resistance at twenty-five and sixty cycles, respectively, and a current density of one ampere per 1,000 circular mils. (4) The impedances for distances under twelve inches is about three times the dead resistance at sixty cycles and 1.7 to two times the dead resistance at twenty-five cycles. With the sheathing and armor grounded at both ends the impedance is somewhat lessened and is largely of the nature of resistance. (5) The impedance of a double-conductor, iron-armored cable, with conductors located 0.873 inch apart between centers, and at the current density given above, is about seven per cent greater at sixty cycles and three per cent greater at twenty-five cycles than the calculated value. The increase is in effective resistance due to eddy currents in the lead sheathing.

There was no discussion on this paper and, owing to the lateness of the hour, the paper entitled "Losses, Induced Volts and Amperes in Armor and Lead Cover of Cables," by H. W. Fisher, was passed until the evening session.

MEETING OF THE SECTION DELEGATES.

On Tuesday evening, prior to the regular session, there was a rousing meeting of the officers of the Institute and delegates from the geographical sections and university branches. About fifty sat down to an excellent repast, and after the dinner several addresses were made by the delegates outlining their methods of developing local sections and the success which had been accomplished. Vigorous addresses were made by President Ferguson, Secretary Pope and Paul Spencer, chairman of the Sections Committee. Mr. Ferguson stated that the board of management was in hearty sympathy with the work that the sections were doing and that they would receive every financial and moral support that was possible. At the same time, the work of the sections entailed a large burden of expense and too much must not be expected of the administration. The local officers of the sections must, by initiative, create an interest in their territories and strive to do as much for themselves as possible. Where papers presented at local section meetings were of such a nature as to be worthy of presentation in the proceedings, this recognition should and would be accorded them. The board of managers had given the matter of section work the most careful consideration, and plans were under way to effectually afford great help and stimulus to this work during the coming year.

Opinions were expressed concerning the necessity and advisability of holding joint meetings with other engineering societies in local sections, as was pointed out by President Ferguson at Atlantic City, to the end that the Institute membership should be preserved and to the discouragement of the formation of specialized and special organizations. Dr. Steinmetz took the lead in suggesting plans for the correlation of effort, and D. B. Rushmore also spoke vigorously upon the necessity of so arranging Institute effort that duplication of work between engineers interested in various phases might be eliminated.

TUESDAY EVENING SESSION.

The paper entitled "Corona Phenomena in Air and Oil and Their Relation to Transformer Design," by W. S. Moody and G. Faccioli, was read by Mr. Moody.

An extensive series of experiments was conducted by the authors on the subject of corona and their relation to electric apparatus, particularly to static transformers. The first series of tests were made on a cylindrical conductor parallel to the plate. Various size wires from one-eighth to one-half inch in diameter were used, at distances from nine to eighteen inches from the plate. A pure sine-wave potential was used throughout. The corona in such cases appeared on the conductor very abruptly, the luminous phenomenon being accompanied by the characteristic noise. For the one-half-inch wire the corona appears at 85,000 volts at a distance of nine inches and at 95,000 volts at a distance of eighteen inches. The condition of the surface of the conductor was found a very important point affecting the final results. A rough metallic spot forming a point on the conductor begins to glow at much lower voltage than the conductor itself. Spots of insulating material on the surface of the rod also began to glow before the body of the rod itself. Such points were eliminated with great care to obtain constant and consistent results. An extended study of their effect was made. It was found that the shorter the length of the rod the greater the voltage required to establish the corona. A further detailed study was made of the development of the corona from the center of the rod toward its ends. In general, all the phenomena were found to be very delicate and affected by very slight changes in condition. It was found that the position of the grounded plate did not affect the location and spreading of the corona; for instance, the removal of the grounded plate entirely, so that the floor, ceiling and walls of the room took its place, did not produce any material change upon the factors just mentioned. A series of tests were made to check the formula that had been developed. While the results of this attempt were rather erratic, still in general it was shown that a small rod at a comparatively great distance from the plate requires a higher voltage than a large rod at a correspondingly small distance from the plate. Another series of experiments was made with a type of condenser having rods forty-five inches long, suspended at both ends by copper wires. These rods were located in the center of a metallic disk. With rods ranging up to one-fourth inch in radius the corona voltage varied from 26,500 to 62,000. Metallic tubes of different lengths were inserted and supported by the cylinder previously used. The longer the cylinder the lower is the corona voltage. Variations of these tests were also made, including the study of the spread of the corona. All these experiments forced the general conclusion that the voltage at which the corona appears in apparatus of limited dimensions depends not only on the dimensions of the apparatus itself and the mutual action of the different parts, but is the complex function of several quantities and conditions. At the close of the paper brief reference was made to the appearance of corona under oil. It was stated definitely that the common belief that oil eliminates corona is not correct. There are really no essential differences in manifestation in air and in oil. For instance, two needles submerged twelve inches apart in oil produce no noticeable glow up to 100,000 volts, but with 1,000 volts more the glow becomes perceptible in the form of a small, steady, noiseless brush, green in color. On further raising of the potentials the brushes increase in size and eventually touch each other, following which soon occurs the disruption of the oil. With needles six inches apart a corona is established at about 78,000 volts; with needles three inches apart the corona starts at about 72,000 volts. In conclusion, the authors emphasize the importance of further study of these phenomena, since their appearance in commercial transformers designed for high voltages becomes a serious problem.

There was a spirited discussion, and the paper entitled "Surges on Cable Systems with Aluminum-Cell Protection," by E. E. F. Creighton and S. D. Sprong, was read by Mr. Creighton.

A series of tests of the large underground cable system of the United Electric Light and Power Company, in Manhattan, Borough of New York city, was conducted by the authors about a year ago and the results are given and discussed in this paper. The distribution is by three-wire, two-phase currents, having 3,000 volts between outer conductors. Each feeder has a motor-operated induction regulator for governing its potential. An aluminum-cell surge protector was connected from the substation busbars to ground. A series of oscillograph records was obtained with a cable grounded and an increasing number of feeders in circuit. Among the leading features noted in the tests were: A gradual decrease in the natural frequency of the circuit as the number of cables in service was increased, thus bringing it within the range of the harmonics of the generator; a general increase of current in the arc to ground with an increase in number of cables; a variable duty required of the surge protector, which apparently depends upon the suddenness of the discharge; a by-pass cell on a potential regulator is called upon to give a high discharge in order to protect the regulator; the maximum surge voltage across the grounded phase of a regulator coil is directly proportional to the maximum surge current to ground; the gap length determines the voltage, and therefore the current of the static charge to the cable; the shorter the gap length, the greater the number of discharges for each alternation of the generator wave. Besides the nearly score of oscillograms shown of this system, two oscillograms are reproduced that were obtained on the Brooklyn Edison system; these show very markedly the superposition of higher harmonics, which are magnified by the capacity so that they predominate over the fundamental.

At the close of the discussion of this paper the paper entitled "Split-Pole Converters and Storage-Battery Regulation" was read by the author, J. L. Woodbridge.

This paper describes the installation and operation of the battery and regulating equipment at the Gary steel works. The battery consists of two sets of 125 cells each, operating in parallel. Each cell has 73 plates, 18.625 inches square. Its capacity is 4,320 ampere-hours at the one-hour discharge rate. The regulating and emergency rates are greatly in excess of this. Discharges as high as 25,000 amperes have been taken from the combined battery. In order to provide for automatic transfer of energy between the battery and the alternating-current system, two split-pole rotary converters have been installed. The auxiliary apparatus for these rotaries is described in some detail. The converters were originally designed as three-part-pole machines, but are now operated with two main pole sections combined as one, and supplied with constant excitation from the exciter busbars; the auxiliary pole is energized from a special synchronous exciter that is connected to totalizing series transformers, which are affected by the fluctuations of the alternating-current load. If this load increases, the exciter current is such as to cause the battery to discharge through the converters; if the load decreases, the exciter current affects the converter so that the battery is charged through it. The degree of regulation can be adjusted to any desired point. Recording-voltmeter charts are shown in the paper to compare the regulation with and without the battery in service. A load curve is also given to show the steadying effect of the battery. It is stated that without the battery it is impossible to maintain satisfactory voltage regulation, and the speed of the gas engines varies over a wide range, while with the battery in service the regulation of speed and voltage is all that could be desired. It also enables the rolling mill to be operated at higher and more regular speed, thus permitting its output to be materially increased. Besides these advantages, the battery is ever ready for emergencies and

thus eliminates costly delays in the operation of the plant.

In discussing Mr. Woodbridge's paper D. B. Rushmore said that this was a description of a specific case typical of general conditions applying in industrial work. The wide fluctuations of load involved were similar to those found in mine hoisting and railway work. It also was a case where the prime mover worked at the best efficiency over a narrow range of output and possibly not at the best speed regulation. The paper also indicated the necessity of continuous operation in this class of work.

The paper by H. W. Fisher, which was left over from the morning session, was then taken up. Mr. Fisher described a number of tests to discover the effects of flow of current in armored single and multiple-conductor cable when the armoring had varying electrical relations with regard to the sheath.

The results of these tests indicated broadly that wherever possible multiple-conductor cable under one armor is preferable to single-conductor cable. It also indicated that it was almost necessary to bond the armor of single-conductor cable to avoid arcing and electrolysis, even when the conductor was laid under water.

During the discussion of this paper Dr. Steinmetz said that it was apparently demonstrated that steel-armored single-conductor cable was unsafe and that the ordinary few tests usually made on cables were not sufficient in this case, but the investigation should be extended over the entire range of normal and abnormal conditions likely to arise in practical operation.

WEDNESDAY MORNING SESSION.

The paper entitled "Electrical Control for Rolling-Mill Motors," by C. T. Henderson, was the first paper read at the Wednesday morning session.

This paper describes the great advances which had been made in automatic control of electrical operations in all phases of steel-mill practice. Marked efficiency now characterized the apparatus used in rolling mills, and these improvements had been possible only by displacing mechanical control by electrical features.

The paper entitled "Automatic Motor Control," by H. E. White, was then read.

Since a few years ago, when the drum controller was quite sufficient for any motor in use, the use of larger motors and the need for automatic features have resulted in the development of a great variety of magnetically controlled switches, and of various means for operating them in control systems. Control by contactors is universally adapted to service under special conditions and a long list of their advantages over other devices was given in the paper. Properly designed contactors have the inherent advantage of opening and closing quickly, thereby lessening the chances of local fusion and consequent wear. Operation at high-contact pressure results in much quicker opening. In case the contactor is required to carry a very large current for a long time, an auxiliary laminated copper contact is used. The magnetic blowout has been found equally effective for both direct and alternating current. Voltage variation greatly affects the operation of contactors, inasmuch as the pull of a solenoid varies approximately as the square of the voltage. With abnormal voltage conditions, therefore, the amount of copper used in the solenoid must be sufficient to carry the current at full voltage without overheating, and to give enough pull at low voltage to insure reliable mechanical action. In the case of contactors operated by alternating current, laminated magnets are necessary to insure operation without excessive heating. The alternating-current contactor closes at a great speed, while the direct-current contactor closes more leisurely, due to self-induction. Humming in alternating-current contactors can be reduced by the use of "pole-shading" devices. In applying contactors to the control of motors a so-called current-limit control is usually employed. In all of the simpler systems the contactors are so arranged that as each one closes it completes the actuating circuit for the next contactor, thereby causing the controlling resistance to be short-circuited step by step. One or more overload relays are so arranged that this progressive action will be interrupted without causing any contactors to be opened whenever the current exceeds a predetermined amount. As soon as the current decreases and the relays fall, the operation is renewed, until finally the motor is operating at full speed. The counter-electromotive-force system was also described and discussed. In some cases, time-limit control is useful; that is, the contactors are arranged so that they will be energized in a given time, regardless of other conditions. In this case an escapement or dashpot is usually employed. The pilot-motor control, as used in printing-press work and in the 2,000 and 6,000 horsepower rolling-mill motors at the Gary steel works, was also described. Two other comparatively distinct systems of current-limit control are also in common use. In one of these a single relay is used, with series and shunt coils. The other system makes use of a separate relay for each contactor. By using separate relays, acceleration can be secured at an increasing, or a decreasing, rate step by step. As ordinarily arranged, each relay is cut out of circuit as soon as the next contactor closes.

In the discussion of this paper, D. B. Rushmore brought up the point that in rolling-mill practice there were many engineering features which it was important for the electrical engineers of steel mills to discuss. He suggested the advisability of these engineers and manufacturers of electrical apparatus getting together for mutual information. He said also that steel-mill operators were realizing the inadvisability of allowing the price of material to govern its purchase. In this connection, when it was so important that the first installations of electrical apparatus must make a good showing, the control of the purchasing should be in the hands of the electrical engineer.

Charles F. Scott called attention to the rapid development which has taken place in the electrical operation of steel mills and said that the electrical engineeer in the steel mill had been rapidly brought forward from a position in charge of a minor part of the equipment to a position of first importance in the whole steel plant. The success of electrical development, therefore, depended largely upon the development of the engineer himself, and a great deal could be gained by the steel-mill engineers discussing their problems with engineers busy in other lines of work.

President Ferguson announced that, as the discussion was becoming very general, he would call for the presentation of the remaining papers and then turn the meeting over to a general discussion.

The paper entitled "Function of Flywheels in Connection with Electrically Operated Rolling Mills," by H. C. Specht, was then presented.

Mr. Specht considers that for all motor drives where load conditions are unstable, especially in rolling mills, the use of a suitable flywheel to take up shock and equalize the unsteady loads is necessary to produce the cheapest installation and to obtain the most satisfactory and economical operation. An equation was analytically evolved by the author showing the relation of the torque of the motor and flywheel, from which several torque curves for different flywheel effects and speed-torque characteristics were shown. From these it was evident that the greater the flywheel effect and the greater the slip for a given torque, the better will be the equalization of loads. Although the best equalizing effect and the highest combined efficiency and power-factor would apparently be obtainable with an automatic control, the load conditions in rolling mills are usually such that an automatic control cannot follow the changes of load, and so its use is inadmissible. In most cases a permanent resistance in the secondary circuit, or a control operated by hand, is most desirable. With regard to the choice of apparatus, the cheapest outfit is not always the most desirable, nor does it always give the lowest operating cost. Even if it requires considerable time to work out the best arrangement in all the details, the entailed expenses will be saved many times in the installation and operation. The author selected a typical illustration of how to arrive at the most economical result and worked out in detail his example, which was selected with load characteristics similar to those of a universal plate or rail mill.

The paper entitled "Power Requirements for Rolling High-Carbon Steel of Small Section," by B. Wiley, followed.

Mr. Wiley's paper consisted of a record of a series of tests taken from a nine-inch merchant mill having seven stands of three-high rolls and one finishing stand of two-high rolls, driven by a two-speed, two-phase, sixty-cycle, 2,200-volt induction motor of squirrel-cage rotor construction, connected to the mill by means of a forty-two-inch three-ply belt. The ratings of the motor are 600 horsepower at 600 revolutions per minute (synchronous speed) and 450 horsepower at 450 revolutions. The pulley reduction gives a mill speed of one-half these values. The product of this mill is high-carbon steel of comparatively small section, and all material is rolled on the slow speed. The flywheel effect of the system is practically limited to that of the rotor of the motor. This effect is comparatively small, as the slip of the motor is but three per cent at full load. The peak load conditions have duration of approximately six seconds. To equalize this load to the average power would require an excessively large flywheel on the mill shaft, and the slip of the motor would have to be increased approximately three times the present value, thereby lowering the efficiency of the motor. From the average working conditions as estimated from the various power curves for usual mill operation, it would require approximately a fifteen-ton flywheel eight feet in diameter, with a ten per cent drop in speed for 250 horsepower increase of load,

in order to lower approximately the peak values of the load. The time and efficiency costs of this equalization do not warrant the use of a flywheel in the system. It is generally supposed that, due to its hardness, more power is required to roll the high-carbon steel than the ordinary mill steel, but at the same temperatures the energy required is practically the same. Owing to the high percentage of carbon the harder steel billet must not be heated as hot as the milder steel, and it is therefore rolled at a lower temperature, the lighter sections being finished at a black heat.

The paper entitled "Alternating-Current Motors Versus Direct-Current Motors in Steel Mills," by K. A. Pauly, was not ready for presentation and was passed over.

An extra paper, entitled "Electrical Problems in Steel Mills," was presented by R. Tschentscher.

Mr. Tschentscher classified steel mills in four divisions, the first class consisting of steel rolling mills where ingots or bars were purchased from other sources. The second class embraced steel-making plants where scrap and raw material were purchased; the third class embraced self-contained plants which handled the raw material and turned out the finished steel; the fourth class embraced self-contained plants with electrical equipment supplying power for other industrial uses.

The plant at South Chicago operated by the Indiana Steel Company is electrically equipped throughout from the unloading of the ore to the finishing of steel plates. A present capacity of 19,000 kilowatts is in operation and 7,000 kilowatts capacity is being added. There are 2,000 motors, with an aggregate horsepower output of 75,000. There is a converter equipment of 7,000 kilowatts capacity and a transformer equipment of 33,000 kilowatts capacity, not including the converter equipment. He did not believe that the first effort should be made to utilize the exhaust steam from non-condensing mill engines, as this put a premium on the retention of this unit. The South Chicago works were installing a low-pressure turbine utilizing the waste steam from the mill engines with a nominal capacity of 7,000 and a maximum rating of 9,000 kilowatts. Where the company was supplying power to other users, power-factor correction had to be watched. The South Chicago company is just installing two 1,600-kilovolt-ampere synchronous condensers at the end of an eleven-mile transmission line which would effect a net saving of $10,000 per year at the delivery point.

In connection with electric-furnace work, the South Chicago plant for the past two months had been using fifteen-ton, three-phase furnaces utilizing 750 kilovolt-amperes at twenty-five cycles. To displace an ordinary open-hearth furnace plant yielding 4,000 tons per day would require from 20,000 to 30,000 kilowatts capacity.

The paper entitled "Rolling-Mill Motors," by E. W. Yearsley, and the paper entitled "Electrically Driven Rolling Mills," by E. Friedlander, were abstracted by Mr. Rushmore.

Large motors, says Mr. Yearsley, should be enclosed in compartments, ventilated by clean air if necessary, or should be of the totally enclosed type, to give protection from dust, moisture, etc. Main motor drives are superior to engine drives, even when power must be derived from a steam engine-driven generator plant fed by coal-fired boilers. Steam losses due to condensation and leaky valves and rings are surprisingly large, but usually escape definite measurement. Where waterpower or waste gas is available there is no question of the greater economy of electric drive. Mechanical strength and simplicity are the main points to be observed in designing controlling apparatus for mill service. Heavier and more mechanical switches and circuit-breakers, better protected and more durable rheostats and more dependable automatic controlling devices, requiring less attention, are badly needed. For large main-drive motors the advantage of continuous running at constant speed is so great that it would appear advisable to make the design of the mill suit the characteristics of the motor, and avoid the extra expense and complication of devices like the reversing drive. There seems to be no great difficulty in designing mills for continuous-running motors. By combining such motors with a suitable flywheel, it should be possible to keep the line load sufficiently uniform. Tests of these characteristics will be comparatively easy on electric mills, so that data will rapidly become available for supplying the system with the proper inertia. The importance of low armature inertia for reversing motors is now well recognized, but designs could be improved by still further reducing in speed. The writer is decidedly against the use of high-speed motors for any kind of mill service and believes the extra cost of slow-speed machines well warranted. For mill apparatus which must be handled directly, especially for direct-current apparatus, the author favors a maximum of 250 volts. Alternating-current and direct-current motors and apparatus both have their advantages for steel-mill installations. Local conditions must determine which is superior. Unless transmissions are too long, the author favors a direct-current installation, especially if the plant has many machine tools.

Mr. Friedlander states in his paper that the introduction of the electric drive in rolling mills has made it possible to get the best relation among rotating masses, speed, time, and horsepower, and has helped the designer to calibrate rolls in such a manner that the power characteristic for all the passes is uniform, thereby avoiding high-power peaks, decreasing the size of the prime mover, and reducing first cost of fuel consumption. The watt-hour meter acts as a continuous indicator diagram to the roller and enables him to tell at a glance just what his rolls are doing and how the steel is behaving in rolling, besides giving much other accurate information on power requirements hitherto unobtainable. The ideal motive power for rolls should drive them slowly when the steel enters and faster as the piece lengthens. For this the characteristics of the electric motor are much better than those of the steam engine. Even with double its full torque the efficiency is good and the motor will not stop. With regard to flywheels, tests have shown that rotating masses are sometimes not only of no use but that they often prove a drag on the motor, necessitating that careful study should be made of each particular case. On blooming and roughing mills, where the pieces are very short and the intervals long, rotating masses supply the largest part of the energy during the rolling period and should therefore be large. The reverse of this takes place at the finishing passes, where pieces are long and follow each other rapidly. Heavy rotating masses would in this case be useless, and would even require larger motors for their quick acceleration. Curves showing the number of pieces in the rolls at the same time, the lengths of passes and intervals, the power required for each pass, etc., should be plotted, where one motor drives roughing and finishing rolls. These will enable the best relation between the sizes and speed of the motor and flywheel, and other data, to be determined. The use of electric motors in place of reciprocating engines renders the operation of the reversing mill nearly automatic; no skilled operator is required and all danger to the motor and mill is eliminated. A motor generator which will give large currents with low excitation, and one that will be quickly magnetized and demagnetized, is needed to facilitate quick reversing. In mill work where power and speed variation are considerable, the direct-current motor, on account of its load and speed characteristics, is better adapted for driving rolls than the alternating-current motor; in fact, for reversible roll drives it is used exclusively. The use of higher direct-current voltages in connection with large rolling-mill motors should be satisfactory; but no doubt high-tension alternating-current transmission and induction motors direct on the line will be generally employed, especially in new installations.

During the discussion of these papers K. A. Pauly said that the use of non-automatic control was to be preferred with rolling-mill motors. Automatic alternating-current contactors had not been sufficiently developed, and direct-current contactors, because of the high resistance in the open coil, were sluggish. There might still be something to be gained, however, in acceleration and retardation over small ranges. The use of permanent resistance eliminated a troublesome part of the equipment.

J. B. Parker said that the advantages of flywheels with electrically driven apparatus obtained in other industrial operations besides rolling-mill practice. The use of the flywheels brings about improvement in the quality of service, particularly with refrigerating machines, where the pulsations of double-cylinder, single-acting plungers caused a bad flickering in the lighting circuit.

Mr. Scott pointed out that usually one of the first considerations in applying electricity to industrial purposes involved the question of the supply of power; this, however, was not the prime consideration, as the power must be used effectively in order to secure successful operation. Rolling-mill operation had its analogy in machine-shop work, where the harmonizing of the motor and the machine tool has brought about a change in the design of the latter.

Mr. White, replying to a question concerning the use of dynamic braking with induction motors, said that no method had been developed which would operate without a tendency to start the motor in the opposite direction after stopping. An effort was being made to apply the retarding current in the reverse phase and

use some other method to shut off the current just as the motor was approaching standstill.

W. H. Abbott contributed an interesting suggestion to the discussion concerning the calculating of flywheel effects. Some time ago, when investigating the amount of variation of speed of a flywheel, he had approached a solution of the problem by plotting a curve of the moving mass upon co-ordinate paper, using time as abscissæ and power as the ordinates. Measuring the distance between the base line and the curve by a planimeter and dividing by the time a line can be drawn through the power curve giving the average power. This may be used as a base, assuming the flywheel to be stationary. From these data can be calculated the energy given to the flywheel. Investigation shows that there is a swinging movement backward and forward of the rotating mass, the impulses in the forward direction being measured by the arcs above the base line and the retarding effect by the arcs below the base line. The curve also indicates that where the power line crosses the average power base line the direction of the flywheel tends to change, and the motion will lag behind the impressed power. Wattmeter curves will show the impressed power, and a calculation can be made for the impressed velocity which will be given to the mass forward and backward.

WEDNESDAY MORNING—PARALLEL SESSION.

The parallel session on Wednesday morning was called to order at 10 a. m. by Paul M. Lincoln, who acted as chairman. The first paper presented was that entitled "Some Considerations in Designing Heavy Capacity Fuses," by L. W. Downes. The paper was abstracted by the author.

The argument of this paper is to show the advantages of multiple-link fuses. A study is made of exactly what occurs when a fuse is blown on short-circuit and it is found that it is extremely desirable to have about the fuse material itself as much filling material as possible in order to cool the resulting gases formed. In order to bring the filling material as completely as possible in contact with the fuse conductor a subdivision of the latter, or an arrangement of it so as to have a maximum amount of surface preferably distributed evenly throughout the area, as it is in multiple-link fuses, is shown to give the best results. A number of tests of enclosed fuses are described and oscillograms are given. These show that the multiple-link fuses invariably operated quietly, whereas the single-link fuses generally burst, the worst case being that in which a single, round wire was used. These results show that where the greatest possible contact with the filling is provided the avenues for the escape of the gases have the greatest extent, and therefore such fuses are the safest to use.

The discussion was opened by C. F. Harding, who noted with pleasure the wide use of the oscillograph for greatly varying sets of conditions. He believed that there must be considerable moisture left in the filling of the fuse and that the testing on short-circuit does not reproduce commercial conditions, since usually the fuse is under heavy load before the short-circuit takes place, and therefore the amount of moisture present would seem to be variable. J. C. Lincoln and W. S. Andrews also discussed the paper briefly.

In closing the discussion Mr. Downes stated that the construction of the multiple and of the single-link fuses that were tested was identical. The filling mostly used consists of different salts of calcium, particularly calcium carbonate and calcium sublimate. This filling contains from sixteen to eighteen per cent of moisture when completed. It is necessary to raise it to a temperature of 600 to 700 degrees to drive the moisture off to any extent. After this has been reduced to about four or five per cent it remains practically constant and is not affected to any extent by atmospheric conditions. The investigations were made in order to find the best method of avoiding the most serious difficulty of enclosed fuses, that is, explosion of the casing. Such explosions have frequently resulted disastrously, and the conditions of the tests were made to correspond to commercial conditions actually met with. In answer to Mr. Lincoln's query regarding the accuracy of the fuse, this depends upon the care with which it is designed. It is not difficult to make a fuse which is correct within ten per cent of its rating. There are two methods of making the reliability of enclosed fuses of a higher order. The most common is the notching of the link to bring about a high current density at the center, and the other is the use of an air drum by means of which a small body of air is confined about the central portion of the link. This latter type of fuse possesses a very high degree of accuracy whether cool or hot. In regard to the use of metals for the fuse link, the harder metals—copper and silver—are not well adapted on account of their higher boiling points.

A paper entitled "Comparative Costs of Twenty-five-Cycle and Sixty-Cycle Alternators," by Carl J. Fechheimer, was then abstracted by the author.

Twenty-five-cycle alternators are known to be more expensive than sixty-cycle machines built for the same output, speed, voltage and phase. In this paper the author endeavors to explain some of the reasons for this increased cost and to point out the actual increase that should be expected. For purpose of comparison sixty-cycle and twenty-five-cycle alternators built for three-phase operations at 2,300 volts and designed in one case for 300 and in another case for 100 revolutions per minute, are considered. The higher speed was taken to apply to water-wheel-driven alternators and the lower speed to engine-type alternators. In each case revolving-field machines with rectangular poles were compared. In twenty-five-cycle machines the flux from each pole is about three times as great as in sixty-cycle machines, but the density used is greater. As more ampere-turns must be used for the lower frequency machines the radial height of the poles is greater. After eliminating all variable costs and reducing them as nearly as possible to the same basis the author concludes that a twenty-five-cycle machine is about 42 per cent more expensive at 300 revolutions per minute and 30 per cent more costly at 100 revolutions per minute than a sixty-cycle machine for the same output, voltage and phase. In small machines for high speed the difference is still greater. The great weight of the field structure for twenty-five-cycle machines guaranteed to stand a large overspeed makes their cost considerably greater. The great length of the end connections of the stator coils for twenty-five-cycle apparatus of large size and high speed necessitates that they be supported. This is not necessary in most sixty-cycle machines and is another element that makes the twenty-five-cycle machine even still more costly than the figures previously given for high-speed machines.

J. C. Lincoln started the discussion by questioning whether the cost of the armature copper and of the field copper is the same at 2,500 kilowatts as is indicated in the paper. Ordinarily the cost of the field copper is several times that of the armature copper for a machine of that size.

M. G. Lloyd thought it was unfair that in comparing the total costs the 300-revolution machine had included its base, shaft and bearings, while the 100-revolution machine cost did not include these items. He also wished to know whether silicon steel had been taken into consideration in any of the calculations, since it seemed to him probable that it is going to be used in alternators and motors.

Mr. Fechheimer replied that the relative proportion of the copper and the iron depend to a great extent upon the excitation used and the degree of ventilation attained. The reason for including shaft and bearings for the 300-revolution machines was that they are intended for waterwheel drive, in which case the generator manufacturer must furnish these parts.

The 100-revolution machines are engine-type generators, for which the engine manufacturer usually supplies the shaft, bearings and base. As to the use of silicon steel, no calculations have as yet been made in comparison, but complete tests are under way with this material also.

In the absence of the author, I. E. Hanssen, his paper entitled "Calculation of Iron Losses in Dynamo-Electric Machinery" was read by title only.

It is well known that the iron losses in motors and generators are greater in actual practice than those that have been calculated from iron-loss curves. In this paper the author discusses some of the reasons for the discrepancy and gives some rules for determining the corrections that should be made to the calculated values. In the case of smooth-core armatures the lack of uniformity of distribution leads to an increase of the losses as does any imperfection in the insulation between disks. To prevent teeth from bulging out extra heavy disks are generally placed at the end of the core and next to the ventilation ducts. In these heavy disks from four to nine times as large eddy-current losses occur as in the thin disks. The magnetic field in the armature is not an alternating one, as is usually the case in tests of iron samples, but is of a rotating nature. Lack of concentricity of the armature and field produces eddy currents in the field poles. Under the best conditions in smooth-core armature machines the actual iron losses are twenty-five to thirty-five per cent greater than those calculated. In toothed

armatures the distribution is still less uniform. The losses due to filing and burrs in the teeth are much greater. In machines having wide-open slots, the variations in gap density are very marked and produce eddy-current losses in the pole shoes. In the case of direct-current and of synchronous machines these losses may also occur in the rotating element.

A written discussion on this paper was submitted by R. E. Hellmund, who thought that Mr. Hanssen's method represents a very good medium between the exact theoretical and the purely empirical formulas. It is a well-known fact that machines of the same type which are manufactured at the same time show core losses differing from each other by as much as twenty per cent, or even more. However, the results obtained from Mr. Hanssen's method always came very close to the average value of the tests on a number of machines of the same type.

A. E. Averrett did not believe that a slight cut in a lathe will increase the service loss as much as fifty per cent. He was familiar with machines in which the results were not affected appreciably by such turning. If the turning is done properly it very seldom increases the core losses to any extent. He advocated the use of silicon steel for high-frequency machines, since it decreases the core losses very much and is therefore desirable in spite of its increased cost.

V. Karapetoff thought that the most reliable procedure in the calculation of core losses was to determine from a large number of machines actually built the exact iron loss at a definite density and at definite frequency and then to use the average of such data. He explained that the photographs given in Mr. Hanssen's paper are not photographs of actual lines of force, but were obtained by Professor Hele-Shaw from fluid flowing between two glass plates; to this fluid coloring matter is added and a projecting lantern is used when the photograph is obtained. These pictures give a good idea of the magnetic distribution, however.

The next paper taken up was that by J. N. Dodd, entitled "Auxiliary Poles for Direct-Current Machines." The paper was read in abstract by the author.

This paper deals with the practical design and testing of commutating-pole machines. The subject of commutation is at first briefly discussed. Perfect commutation occurs when the current is divided equally over the surface of the brush and where the rate of reversal is the same at all points. In order to obtain this, three conditions must be present: (1) Each bar must make perfect contact with the brush over its entire surface. (2) The resistance of contact surface between brush and bar must be high with respect to the resistance of the coils or of the connections to the commutator, otherwise the edges of the brush will carry more than their share of the current; this condition is practically attained by the use of carbon brushes. (3) There must be no electromotive-force generated in the coils short-circuited by the brush; this is the principal cause of poor commutation. The fundamental necessity for auxiliary poles lies in the need of annulling the armature flux, and particularly that part of it passing through the commutated coil, in order that equally good commutation at full load and no load should result. In designing auxiliary poles, the first step is to calculate the voltage of armature self-induction. A wide pole-face is desirable, as the pole tip must cover the extreme positions occupied by any of the armature coils at the time of commutation. The flux passing through the auxiliary pole should be proportional to the load, i. e., the pole must be unsaturated up to the specified overload limits. The curves of armature induction and of auxiliary pole flux when plotted should coincide to insure sparkless operation. Two causes might prevent this coincidence: (1) not enough turns on the auxiliary coil, and (2) saturation of the auxiliary pole at full load. The first can be remedied by adding turns, the second is almost hopeless, especially for high-speed machines. After giving an example of auxiliary-pole design, the paper is concluded with some notes on the exact testing of the efficacy of the auxiliary poles. The best way to make the test is to measure the voltage between points on the commutator under the brush with a low-reading, direct-current voltmeter. If a zero reading results from this measurement, the armature flux has been properly annulled, and if the mechanical condition of the commutator and brushes is good, the commutation will be perfect.

Cyril J. Hopkins discussed the subject of air gap in railway motors having commutating poles. With motors that do not possess the auxiliary poles the air gap is usually determined by the necessity for satisfactory commutation, while with commutating pole motors the air gap length is much diminished and is limited by the necessity of considering the wear of the bearings. It is desirable to allow as much as possible in the wear of bearings so as to get a reasonable length of service from the motor before it becomes magnetically unbalanced, and it seemed to him that with a diminished air gap that the same amount of wear would produce unbalancing sooner than with a long air gap. It was desirable therefore to make use of ball bearings which should not show any appreciable wear.

J. C. Lincoln described graphically the method of calculation he had made use of. This was especially to get an absolutely straight line of the speed with a change of load. Professor Karapetoff endorsed Mr. Lincoln's method of calculation which is to put enough ampere turns on the pole to neutralize the armature reaction. The commutating pole must give such a flux that the conductors that are short-circuited and pass under the commutating pole induce a voltage equal and opposite to the voltage of self-induction.

C. A. Adams stated that Mr. Dodd's method is not strictly a new one, but his explanations are from a new point of view. He believed it desirable to separate the main armature flux from the flux which is due to the coil undergoing commutation. With the ordinary number of coils it is impossible to include that with the armature flux, as Mr. Dodd seemed to have done.

The discussion was concluded by Mr. Dodd, who stated that the present paper had not taken account of railway motors, but was confined almost entirely to generators. He explained his method of making the voltage test on the commutator bars under the brush. He believed his method of calculation agreed with that described by Mr. Lincoln.

The paper on "Electric Measurements on Circuits Requiring Current and Potential Transformers" was then abstracted by its author, L. T. Robinson.

The growing use of current and of potential transformers in connection with measuring instruments requires that an exact knowledge be possessed of the transformation ratios and the relation of phase angles in various conditions of frequency, voltage, and power factor of the circuit being tested. The author, therefore, discusses at first the errors in the use of commercial ammeters, voltmeters and wattmeters. The use of these transformers, in connection with wattmeters, is liable to be the most prolific source of errors. Tables of connections for use with wattmeters are given. From the table it can be seen that within certain limits of accuracy and power factor the correction for phase angle may be neglected. The current transformer is then considered somewhat in detail and the method of determining the exact ratio and phase angle by means of reflecting dynamometers is described. The method of determining the ratio by means of current-carrying resistances and an alternating-current comparator was also described. A similar study is then made of the potential transformer. Various methods for the accurate determination of the ratio and phase angle are given in detail. In conclusion, it is pointed out that if current and potential transformers are carefully designed they may be used with small errors resulting from the various devices connected with the secondary circuit and with the primary current varying between the limits of the connected instrument scales, and also with the voltage and frequency variations met with in commercial practice. If care is not used is selecting suitable apparatus for particular conditions, errors as great as five or ten per cent, or even more, may occur. Where low power-factor is present or where a high degree of accuracy is required carefully determined corrections for ratio and for phase angle must be applied.

Clayton H. Sharp said that, in order to get the best results in the measurement of the ratio of current transformers, the two instruments used should have as nearly as possible the same natural frequency of oscillation. The method which Mr. Robinson outlined is one that has been used in his laboratory for several years. It is a bridge or zero method, in which the result is obtained in terms of the ratio of two resistances. He had found the use of the rotating commutator rather unsatisfactory and described several methods for eliminating it. His method dispensed with the necessity for using two wattmeters and did not require three observers and a steady current. The entire apparatus can be attached to a switchboard and the measurement of the transformer ratio and its phase angle made on the transformer in place. He had with him some of this apparatus, which on account of the lateness of the hour he did not explain in detail.

M. G. Lloyd described the methods made use of at the Bureau of Standards, Washington, D. C. He also did not get

good results with the use of a rotating commutator. The determination of the phase angle was made almost simultaneously with the transformer ratio. In general it can be said that an instrument transformer is a precise piece of apparatus when it is used under proper conditions. There is one way in which error may be introduced even when the transformer has been properly calibrated and when it is not subject to aging. This is due to the fact that iron in some cases requires a different magnetizing current than it does in other cases. This may be brought about by magnetizing too highly in one direction and then subsequently breaking up the magnetizing current. He thought that the matter of wave form should have been taken up by Mr. Robinson.

The paper was also discussed by John W. Dorsey, L. W. Chubb, Albert F. Ganz, and by Mr. Robinson.

The last paper at this session was that entitled "Electromotive-Force Wave-Shape in Alternators," by Comfort A. Adams. It was presented in abstract by its author.

The shape of the electromotive-force wave of an alternator at no load is dependent upon the shape of the flux-distribution curve and upon the arrangement of the armature conductors. The electromotive-force of one phase of an alternator is generally made up of several of the slot electromotive-forces added together with their proper phase relation, the electromotive-forces of two adjacent slots being displaced by an angle corresponding to the slot pitch. In adding the slot electromotive-forces it is necessary to analyze the flux-distribution curve into its fundamental and harmonics and to make a vector addition of the fundamentals in the proper slot electromotive-forces and separately of the corresponding harmonics to get a fundamental and a set of harmonics, which when combined give the complete phase electromotive-force. This method of the author is then applied to various types of armature winding. A summary of this study shows that there are several differential actions combining to reduce the electromotive-force induced in the armature of the alternator, but they affect the fundamental and the various harmonics in different degrees, the amount of reduction of the fundamental being in general very small as compared with that of the harmonics. These differential actions are classified as follows: Belt differential action, between the several slots of each phase belt; pitch differential action, between the two belts of each coil group; mid-coil differential action due to the mid-coil connection and the consequent equivalent widening of each belt, and phase differential action, between two phases connected in series as in three-phase star connections. By proper combination of these various differential actions it is possible to reduce all the harmonics of an alternator electromotive-force to very low values without seriously reducing the fundamental even when the flux distribution is far from sinusoidal. The paper is concluded by giving a number of examples of the author's method of relating the shape of the flux distribution curve to that of the electromotive-force wave.

This paper was briefly discussed by J. C. Lincoln and Mr. Adams, after which the meeting adjourned.

THURSDAY MORNING'S SESSION.

The first paper called for on Thursday morning was entitled "The Modern Telephone Cable," by F. B. Jewett, which, owing to the absence of the author, was passed over.

A resolution of thanks was offered to the American Telephone and Telegraph Company and to the Central New York Telephone and Telegraph Company for the local and long-distance telephone privileges which had been accorded to the members. A resolution was also introduced thanking the members and associates who had contributed to funds for entertainment, these funds having been secured entirely without aid from anyone connected either directly or indirectly with the manufacturing interests.

The paper entitled "The Training of Non-Technical Men," by C. R. Dooley, was read.

This paper describes the work which is carried on at the Casino Night Technical School at Pittsburg.

The author, in the course of his highly suggestive paper, gave an account of the educational activities of the Westinghouse interests at East Pittsburg, Pa., in the training of non-technical men. Accounts of the apprenticeship system and of the night schools were given in which was shown the extraordinary effort put forward by instructors (themselves practical men in employment at the works) and also by the students to their mutual instruction and upraising. In conclusion, he said that while it is not within the province of a manufacturing concern to provide a liberal education for its men, with the present degree of education among young men it is within the principles of good business to provide and maintain a training in those fundamental subjects which will assist in developing skilled mechanics and workmen of higher ideals to carry on the business of the future.

The paper entitled "The Value of the Classics in Engineering Education," by Dr. C. P. Steinmetz, was briefly abstracted by the author.

Education is not the learning of a trade or profession, but it is the development of the intellect and the broadening of the mind, afforded by the general knowledge of all subjects of interest to the human race. It is the stock-in-trade which enables a man intelligently to attack and solve problems for which no previous data exist. These problems are practically the same in all walks of life, and the general education of the mind and intellect required by engineers, lawyers and physicians, and all other professional men is practically the same. The only differences in the various professions are those pertaining to the specific instructions and the study of the details of the peculiar branch of human knowledge which will be the life work of the student. The study of the Latin and Greek languages has been for ages the foundation for all education, and the latter-day neglect of the classics, owing to the development of empirical science and its application, is to be deplored. There is a considerable utilitarian value in the study of these languages and the terminology of science is entirely based on Latin forms with Greek and Latin roots. The modern languages are not in the same class with the classic languages and to the engineer particularly the knowledge of them offers no appreciable help in following the engineering progress of other countries, as practically all that is worth reading is translated into English either in full or in abstract. Even to a reader who has made considerable progress in a modern language the lack of knowledge of the technical terminology of that language is often an unsurmountable barrier. Since the modern languages have no appreciable educational value they should be dropped from the engineering curricula of our colleges. The author concluded his paper with an outline of his proposed methods of classical instructions and with a résumé of the best authors to be studied in this connection.

This paper was supplemented by a letter from F. P. Fish, who said the Institute was under an obligation to Dr. Steinmetz for the preparation of this paper. Too many of the members have given little consideration to this subject. Mr. Fish was in full agreement with the general principles of Dr. Steinmetz's paper and considered it unfortunate that many engineers did not have the opportunity of studying the great authors of Greece and Rome. Anyone, he thought, who studied the classics was better fitted to take a sane view of broad topics and was a better judge of human nature. The literature of other lands should also be given considerable study.

Prof. C. A. Adams said it was a matter of great interest to witness the change which had come about in the attitude of manufacturers in the treatment of employes, and that today men were giving greater consideration than ever to the improvement of the men at work in the shops. He did not agree entirely with Dr. Steinmetz that the study of the classics was essential to proficiency in engineering. It was a fine thing to have, but in the present day it was not likely that boys undertaking the study of engineering work would take kindly to the study of classics.

Charles F. Scott called attention to the severely commercial aspect of Mr. Dooley's paper, and said that the work described fulfilled the important and essential conditions for engineering training. He agreed in general with Dr. Steinmetz that great breadth of knowledge and culture were of value, but considered that we had been getting away from speculative and philosophic lines of thought in our assumption of scientific grappling with the problems of today.

Farley Osgood said that there appeared to be a tendency in the engineering colleges to train men to become designers and manufacturing engineers rather than operating engineers. One of the greatest difficulties public-service corporations have is getting young men from college who have been properly trained to become good managers and executives. The operating engineer meets with a multiplicity of problems, coming at him quickly, and he must be a rapid, accurate thinker. Further than this, his success will largely depend upon his ability to so describe his needs and the logic of their being met that the people upon whom he must depend for the money to carry out his enterprises will be convinced that he is correct in his conclusions.

Dr. M. G. Lloyd said there was no doubt of the value of broadening our educational endeavors, and we should seek to apply these efforts so as to make the benefit possible to all young men. The conditions are general and not peculiar to engineering, and are extraneous to technical training. Emphasis should be placed on the importance of teaching languages and kindred subjects in the lower grades and keeping scientific studies upon a higher plane.

J. B. Parker said that the work described by Mr. Dooley and the results which were being achieved indicated a way in which we may realize the fundamentals of our democracy in doing away largely with class consciousness.

D. B. Rushmore said that one of the first questions to be answered looked to a reasonable analysis of what we are trying to do. All men have to perform a multiplicity of functions, chief of which apparently was the necessity of providing a livelihood. Apparently in the last analysis a man must confine himself very closely to what is going to be his lifework.

Dr. C. H. Sharp said that if the engineer was going to be not merely an engineer but a leader in human affairs, he must have a broad cultural training. The teaching of languages was largely a waste of time unless they were so taught as to persuade a mastery sufficient to absorb the spirit of the original writing. He thought we should do more of what the schools of law, theology and medicine are doing and secure as students for engineering institutions young men who had had considerable classical education.

J. G. White made a strong plea for a more consistent and coherent study of English in our engineering schools and also expressed the opinion that Spanish should form a part of the student's opportunities.

Dr. George F. Sever raised a note of warning against adding to the complexity and extending the variety of subjects taught in engineering schools. If we aspire to the broad cultural lines indicated by Dr. Steinmetz, we will have to extend our courses. He believes, however, that any man who had been properly trained as an engineer could make himself a scholar through individual work.

Mr. Rushmore, at this point, took occasion to point out the very happy condition which had marked every event of the present convention and the splendid results which had attended Mr. Ferguson's administration. He said that probably never before had the personality of the president been so definitely felt in the administration of affairs. The board of managers had decided to take a step in recognizing the services of the president for the first time this year, and as a token of their appreciation took the highest pleasure in presenting to Mr. Ferguson a gold medal.

Mr. Ferguson made a brief reply to Mr. Rushmore and said that for whatever success had been achieved he took no personal credit, that it was entirely due to the board of managers and the officers and members of the various committees, upon whom the greatest variety and volume of work was incumbent, and to whom should be extended the appreciation of every member of the Institute.

In closing the discussion on the educational papers, Dr. Steinmetz said that the earning of money as a purpose in life was the mistake of our age and nation. The suggestions he had made in his paper were only a few of the many possible solutions. He thought that there should be interposed between the high school and the college a course in the classics and that the engineer, after graduating, should have a rounding-off period. This would mean a period of twelve years from the time of entering high school to entrance into the profession. What should be done immediately, however, was to recognize classic languages as equivalent to modern languages. The student should have a choice of Latin, Greek, French, German and Spanish, two of these being selective.

The paper entitled "Pole-Face Losses," by C. A. Adams, A. C. Lanier, C. C. Pope and C. O. Schooley, was abstracted briefly by Professor Adams.

Experiments were undertaken to establish a reliable and, if possible, a rational quantitative relation between the pole-face losses and the principal variables involved therein. In any dynamo-electric machine with a toothed armature the magnetic flux density at the pole-face opposite a tooth is greater than that opposite a slot, and as the armature rotates, the teeth carry waves of flux across the pole-faces. At the ordinarily high tooth frequencies the eddy-current loss predominates; with solid pole-faces the hysteresis loss is negligible. The transverse portions of the eddy-currents are the ones which will produce the damping of the flux pulsations and are predominant in the case of solid shoes. These are called the "damping currents." Those parts of the eddy currents in the circumferential direction are ordinarily relatively small, and as their tendency is to screen the center of the pole from the flux pulsations and to drive the latter to the two circumferential edges, they are called the "screening currents." With laminated pole shoes the screening currents predominate and the damping currents are reduced in magnitude and effectiveness; that is, the pulsations will penetrate much deeper into the pole shoe and the advantage of the laminations will be considerably neutralized. The chief difference between the damping and screening currents is that whereas the damping currents tend to force a more uniform flux distribution, the screening currents tend to disturb an otherwise uniform flux distribution over the section of the laminas. Both tend to increase the reluctance of the magnetic circuit and to decrease the eddy-current loss. The screening currents, however, tend to increase the hysteresis loss. Another source of energy loss in the pole face, often of considerable magnitude, is that due to the pulsation of reluctance of the main magnetic circuit caused by a variation in the number of teeth under a pole. This has been overlooked in previous investigations. A mathematical analysis of pole-face losses followed, after which was given an account of the results of the experiments undertaken by the authors. The machine employed was provided with detachable poles and pole shoes, and with three armatures, each with a different number of teeth. Three sets of pole shoes were used, one set of solid annealed steel castings, one set of 0.014-inch laminations, and the third set with 0.06 laminations. Constant speed tests and constant flux tests were made. The most important experimental data were summarized in curves showing the relation of the pole-face watts per square inch to the ratio of slot opening to air gap. The effect of the reluctance pulsation was averaged out and the curves then showed the largest pole-face loss in the case of the solid pole shoes. The effect of laminating pole shoes was discussed more or less in detail, as was an inquiry into the additional pole-face losses due to rivets, screws, etc.

Farley Osgood said that Professor Adams should be thanked for the spirit of his presentation, and that this paper would be peculiarly appreciated for its usefulness.

Mr. Rushmore said that it was to such papers as this that we owe our continuous advancement in the development of electrical apparatus.

Dr. Steinmetz said that it was immaterial whether a paper such as this came at the beginning or at the end of a convention; it was not for discussion, but for perusal and use, and he thought that no one would disagree with him in hailing Professor Adams as the leading designer of electrical apparatus of our American universities.

The convention then adjourned.

ENTERTAINMENT.

On Monday evening there was a reception and dance at the Hotel Frontenac, followed by a buffet supper. On Tuesday afternoon the qualifying round in a handicap golf tournament was played, the first eight qualifying for the semi-finals. There was also a woman's putting test, the first prize, a solid silver cardcase, going to Mrs. Louis A. Ferguson. The second prize, a gold-enameled belt-buckle, was won by Miss Alice A. Reed. For the third prize, a topaz hatpin, three ladies were tied, the play-off being won by Mrs. F. A. Donohoe. Mrs. W. I. Schlichter and Mrs. H. G. Reist made high scores, giving Mrs. Donohoe a hard contest for third prize.

On Tuesday evening there was a woman's bridge tournament, the first prize, a pearl brooch-pin, being won by Mrs. J. M. Wakeman. The second, a fine pair of gold-enameled bar pins, was won by Miss Alice A. Reed.

In the qualifying round of the handicap golf tournament the best gross score was made by F. A. Donohoe, winning as a prize a handsome mahogany humidor. A solid silver safety razor set was the prize of F. P. Cox for the best net score.

On Wednesday afternoon the semi-finals of the golf match were played off, Louis A. Ferguson and A. I. Totten qualifying, with Mr. Ferguson allowing Mr.

Totten twelve strokes in the final. The driving contest was won by Professor C. A. Adams, the second prize going to C. W. Stone. There was also an exciting baseball game between two teams designated as the "Has Beens" and the "Never Was," the latter winning by a score of twenty-one to twenty. The game afforded many a laugh for the spectators and a good deal of excitement and fun for the players. There was one casualty, Professor Langsdorf receiving a dislocated shoulder as the result of a collision with Mr. Tillman.

The fine eighteen-hole golf course offered a great opportunity for the enthusiasts and the lure of the links rivaled the technical sessions in attractiveness.

On Wednesday evening there was a fifty-mile searchlight trip among the islands on a large steamer for both the ladies and gentlemen.

On Thursday afternoon the finals on the golf tournament resulted in a victory for Mr. Totten, who won with one up, Mr. Ferguson almost overcoming his handicap of twelve strokes.

The prize for the largest fish went to Mr. John H. Finney and for the largest catch to Frank H. Gale.

The following were in attendance:

Louis A. Ferguson, Chicago; Ralph W. Pope, New York; James G. White, New York; Calvert Townley, New Haven; Paul Spencer, Philadelphia; Paul M. Lincoln, Pittsburg; Percy H. Thomas, New York; Morgan Brooks, Urbana, Ill.; David B. Rushmore, Schenectady; W. G. Carlton, New York; Charles W. Stone, Schenectady; A. W. Berresford, Milwaukee; D. Frederick Schick, Philadelphia; S. D. Sprong, New York; Earl Wheeler, Washington, D. C.; W. N. Ryerson, Duluth; F. Creedy, Pittsburg; Frank H. Gale, Schenectady; F. L. Hutchinson, New York; M. O. Troy, Schenectady; Cyril J. Hopkins, Philadelphia; M. G. Lloyd, Washington, D. C.; Howard S. Knowlton, Boston, Mrs. Howard S. Knowlton, Boston; Martin P. Rice, Schenectady; H. G. Reist, Schenectady; Mrs. H. G. Reist, Schenectady; Charles F. Scott, Pittsburg; Brent Wiley, Pittsburg; Mrs. Brent Wiley, Pittsburg; Clarence Selden, New York; Mrs. Clarence Selden, New York; Mrs. Louis A. Ferguson, Chicago; H. H. Barnes, Jr., New York; C. T. Henderson, Milwaukee; R. J. Randolph, Jr., New York; Mrs. S. D. Sprong, New York; James H. Harnden, New York; Mrs. James H. Harnden, New York; John C. Reed, Steelton, Pa.; Charles T. Mosman, Boston; J. G. Zellar, New York; Floyd A. Norris, Brooklyn; Frank R. Schalck, Chicago; C. A. Adams, Cambridge, Mass.; Mrs. C. A. Adams, Cambridge, Mass.; J. M. Wakeman, New York; Mrs. J. M. Wakeman, New York; Arthur B. Lisle, Providence; Mrs. Arthur B. Lisle, Providence; John B. Given, New York; Farley Osgood, West Orange, N. J.; Mrs. Farley Osgood, West Orange, N. J.; August H. Kruesi, Schenectady; Charles A. Terry, New York; Mrs. Charles A. Terry, New York; Miss Catharine L. Terry, New York; Matson C. Terry, New York; T. N. Hicks, Niagara Falls; C. E. Robertson, Toledo; James F. Kinder, New York; A. E. Kennelly, Cambridge, Mass.; E. F. W. Alexanderson, Schenectady; Mrs. E. F. W. Alexanderson, Schenectady; Mrs. J. G. White, New York; J. D. White, New York; Lewis B. Stillwell, Lakewood, N. J.; Mrs. Lewis B. Stillwell, Lakewood, N. J., W. F. White, New York, Mrs. W. F. White, New York; Foster White, New York; Frederic White, New York; W. A. Hall, Pittsfield; E. P. Peck, Atlanta; R. F. Schuchardt, Chicago; Mrs. R. F. Schuchardt, Chicago; Walter I. Slichter, Schenectady; Mrs. Walter I. Slichter, Schenectady; John B. Taylor, Schenectady; Mrs. John B. Taylor, Schenectady; W. I. Donshea, Brooklyn; Miss Jane E. Donshea, Brooklyn; Dugald C. Jackson, Boston; Mrs. Dugald C. Jackson, Boston; W. L. Abbott, Chicago; K. A. Pauly, Schenectady; E. A. Wagner, Fort Wayne; H. L. Wallau, Cleveland; C. W. Ricker, Cleveland; W. B. Brady, Cleveland; L. T. Robinson, Schenectady; O. A. Kenyon, New York; C. E. Magnusson, Seattle; A. E. Averrett, Schenectady; Antonio Guell, Urbana, Ill.; William H. Horton, St. Catherines, Ont.; G. Faccioli, Pittsfield; Mrs. P. M. Lincoln, Pittsburg; Henry W. Fisher, Pittsburg; Tracy D. Waring, Perth Amboy, N. J.; Prof. Dalemont, University Fribourg; L. W. Chubb, Pittsburg; H. C. Specht, Pittsburg; Azel Ames, Yonkers, N. Y.; J. C. Lincoln, Cleveland; A. H. Armstrong, Schenectady; Albert F. Ganz, Hoboken; Floyd W. Smith, Canton, N. Y.; S. B. Charters, Jr., Stanford University, Cal.; V. G. Converse, Niagara Falls; Mrs. V. G. Converse, Niagara Falls; Charles D. Knight, Schenectady; W. S. Andrews, Schenectady; A. Clarke, Folsom, W. Va.; W. S. Lee, Charlotte, N. C.; E. P. Coles, Charlotte, N. C.; F. M. Farmer, New York; Charles E. Waddell, Biltmore, N. C.; James L. Chaphe, Cazenovia, N. Y.; W. E. Rundle, New York; Harry Barker, New York; F. B. H. Paine, Buffalo; Mrs. F. B. H. Paine, Buffalo; Francis E. Donohoe, New York; Mrs. Francis E. Donohoe, New York; V. Karapetoff, Ithaca; Mrs. V. Karapetoff, Ithaca; Ainslie A. Gray, Chicago; M. C. Beebe, Madison, Wis.; Henry A. Reed, Newark, N. J.; Mrs. Henry A. Reed, Newark, N. J.; Miss Alice A. Reed, Newark, N. J.; Henry W. Peck, Rochester, N. Y.; L. C. Nicholson, Buffalo; George F. Sever, New York; B. E. Kenyon, Austin, Tex.; Thomas R. Rosebrugh, Toronto; Hall F. Hoxie, Ridgewood, N. J.; C. L. de Muralt, New York; Mrs. C. L. de Muralt, New York; Master Carl de Muralt, New York; G. H. Reid, Schenectady; H. D. Garretson, Warsaw, N. Y.; T. C. Martin, New York; Mrs. R. W. Pope, Elizabeth, N. J.; Miss Mary E. Durant, Elizabeth, N. J.; Alexander Maxwell, New York; J. S. Van Bylevelt, Cambridge, Mass.; Mrs. C. C. Townley, New Haven; Charles W. Miller, Rochester, N. Y.; C. N. Pratt, Rochester, N. Y.; Andrew Pinkerton, Pittsburg; E. E. F. Creighton, Schenectady; S. H. Blake, Pittsfield; G. N. Chamberlin, Swampscott, Mass.; Henry Price Ball, Pittsfield; John B. Whitehead, Baltimore; J. L. R. Hayden, Schenectady; Charles P. Steinmetz, Schenectady; Frederick Bedell, Ithaca; C. J. Fechheimer, Milwaukee; L. B. Cramer, Portland, Ore.; John C. Parker, Rochester, N. Y.; R. H. Tillman, Rochester, N. Y.; A. M. Dudley, Swissvale, Pa.; John H. Finney, Washington; J. W. Fraser, Charlotte, N. C.; J. L. Watson, Atlanta; John W. Dorsey, Schenectady; Arthur Simon, Milwaukee; J. Mason Knox, Schenectady; Mrs. J. Mason Knox, Schenectady; J. E. Jennings, New York; Mrs. J. E. Jennings, New York; T. E. Crossman, New York; Clayton H. Sharp, New York; Miss Dorothy M. Sharp, White Plains, N. Y.; Walter S. Moody, Schenectady; Mrs. Walter S. Moody, Schenectady; Miss Jean Moody, Schenectady; Frank J. Sprague, New York; Mrs. Frank J. Sprague, New York; Mrs. I. M. McKinnon, New York; Ellery B. Paine, Urbana, Ill.; A. S. Langsdorf, St. Louis; C. W. Koiner, Los Angeles; A. H. Lawton, New York; Frederick A. Stoughton, Massena; Lewis R. Mather, Utica; William S. Aldrich, Potsdam, N. Y.; Byron F. Burch, Potsdam, N. Y.; A. W. Henshaw, Schenectady; Henry H. Humphrey, St. Louis; William B. Hale, City of Mexico; H. Frodsham, Schenectady; Mrs. C. W. Stone, Schenectady; John W. Upp, Schenectady; H. E. White, Schenectady; Mrs. H. E. White, Schenectady; F. W. Throop, Niagara Falls; Philip B. Woodworth, Chicago; J. Lester Woodbridge, Philadelphia; J. L. Burnham, Schenectady; Miss Helen Robinson, Providence; A. I. Totten, Schenectady; Mrs. A. I. Totten, Schenectady; Mrs. R. J. Randolph, Jr., New York; A. R. Sawyer, East Lansing, Mich.; Mrs. A. R. Sawyer, East Lansing, Mich.; C. R. Dooley, Pittsburg; Mrs. C. R. Dooley, Pittsburg; Lewis L. Holladay, Charlottesville, Va.; R. H. Taber, Worcester Polytechnic Institute; John Langan, New York; E. W. Allen, Schenectady; N. J. Neall, Boston; F. P. Cox, Lynn; Jean R. Wagner, New York; Ralph D. Mershon, New York; Edward Van Wagenen, New York; A. D. Robb, Niagara Falls; H. B. Alverson, Buffalo; Robert Charles Cole, Hartford; C. Francis Harding, La Fayette, Ind.; Robert L. Allen, Syracuse; C. P. Ackert, St. Louis; Howard R. Sargent, Schenectady; Louis W. Downes, Providence; W. Butler, Lockport, N. Y.; Mrs. W. Butler, Lockport, N. Y.; H. M. Van Gelder, New York; Mrs. Therese Fechheimer, Altoona, Pa.; J. N. Dodd, New York; Mrs. G. S. Mather, Utica; Robert N. Davidson, Salt Lake City; Edward L. Nichols, Ithaca; W. Edgar Reed, Pittsburg; Charles A. S. Howlett, Chicago; S. W. Mauger, Schenectady; A. U. Hart, Hamilton, Can.; Morse O. Dell Plain, Syracuse; Arthur C. Eastwood, Cleveland; R. I. Wright, Cleveland; R. Tschentscher, Chicago; Charles F. Hunter, Albany; W. A. Blanchard, Syracuse; William A. Bucke, Toronto; W. G. Kellogg, Ogdensburg; Mrs. W. G. Kellogg, Ogdensburg; Miss Ethel A. Egert, Ogdensburg.

For Extra Subway Tracks.

The New York City Board of Estimate has appropriated $875,000 for turning the Chambers Street station of the Brooklyn loop line of the subway from a four-track to a six-track way. It is estimated that about $1,000,000 besides this will be required for acquiring additional property.

Moving Platform Subway.

The New York Public Service Commission has sent to the Board of Estimate of New York city a letter asking that a special committee consider moving platforms during the summer months. The proposition the commission has in mind is for a moving platform subway, as submitted by E. P. Ripley, president of the Atchison, Topeka & Santa Fe, and Max E. Schmidt, president of the Continuous Transit Securities Company, to run from Tenth Street to about Forty-second, which the commission says can be operated without interfering with other rapid-transit routes, and from its point of view appears to be feasible and desirable. Chairman Willcox says: "At the present time the matter has not reached the stage where it could be either formally or completely submitted to you, but in view of the early adjournment, the commission desires to call the general subject to your attention and to suggest the advisability of the reference of this matter to a committee so that it may be taken up during the summer months."

More Electrification.

The Colorado & Southern Railroad is preparing to electrify its road from South Park, Colo., to Clear Creek, Colo., and to Estes Park, Colo., making these branches part of the Denver terminal. John F. Stevens, vice-president of the New York, New Haven & Hartford Railroad, will prepare the plans and look after the arrangements in place of J. J. Hill, the president of the road. Plans will also be submitted for a $1,000,000 power plant, to be located at Mill Gulch, in the South Platte Valley, to furnish the power for a part of the line, while it is understood that the Central Colorado Power and Lighting Company will furnish the power for the other part of the line.

Lighting Plant for Pennsylvania Terminals and Tunnels.

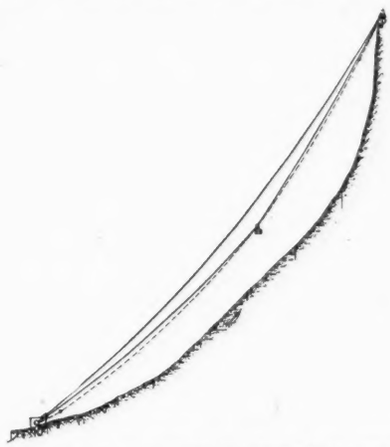
The Pennsylvania Tunnel and Terminal Company, operating the Pennsylvania Railroad tunnels under New York city and the rivers, is installing in its Long Island City power house two Westinghouse turbine-alternator sets of 2,500 kilowatts capacity each, for lighting the tunnels and terminals. The dependability required in this service has demanded that every precaution be taken to insure absolute continuity of operation of the generating and distributing systems. The alternators will supply three-phase, sixty-cycle current at 440 volts.

THE WETTERHORN CABLE ROAD OF THE GRINDELWALD GLACIER, SWITZERLAND.

BY FRANK KOESTER.

A very unique electrically-operated cableway, the first of its kind, has recently been installed in the Bernese highlands, Switzerland, to make the journey part way up the Wetterhorn Mountain. While the topmost peak of the Wetterhorn is 12,150 feet above sea-level, the first section of the cableway, at present constructed, conveys the tourist 1,377 feet from the lower station at the Wetterhorn Hotel, near the upper Grindelwald Glacier, 5,500 feet above sea-level.

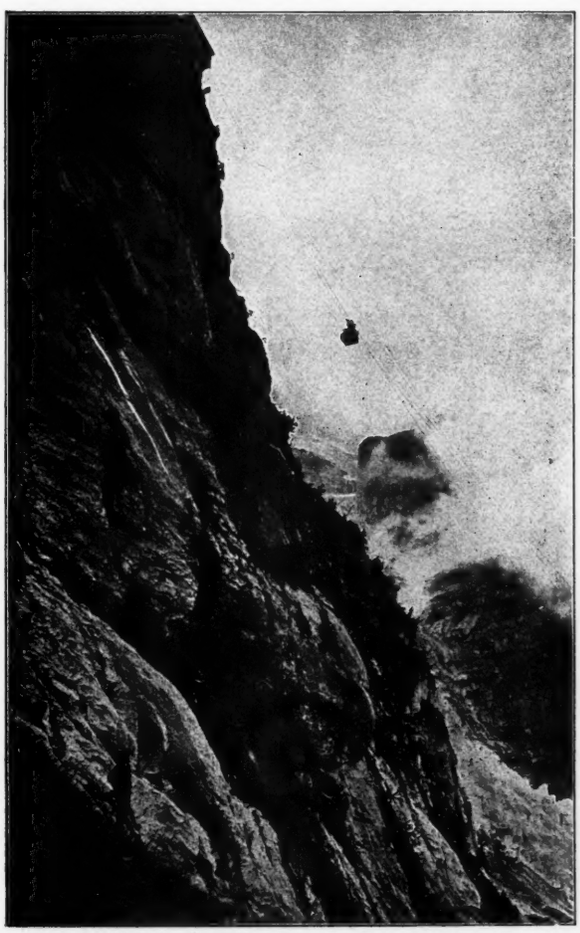
The method adopted is the Feldmann cable system. Its principal advantages are quick and direct transit between high mountain points and exceptionally low first cost and cost of maintenance, as compared with other mountain railways. Before describing the installation, a rough outline of the system will be given: Two sets of cables are stretched between the lower and upper stations. The two trolley cables for each hoist are not placed side by side, but one above the other, to secure stability in operation. The upper ends of each set are securely anchored, while the lower ends form a loop by a short Gall's chain, provided with a counterweight to maintain tautness. The trolley, from which the car is suspended, runs on these cables and is drawn by a pair of hoisting cables. The latter are so connected, that when one car ascends, the other descends, thus counterbalancing one another. The hoisting apparatus is located in the upper station.



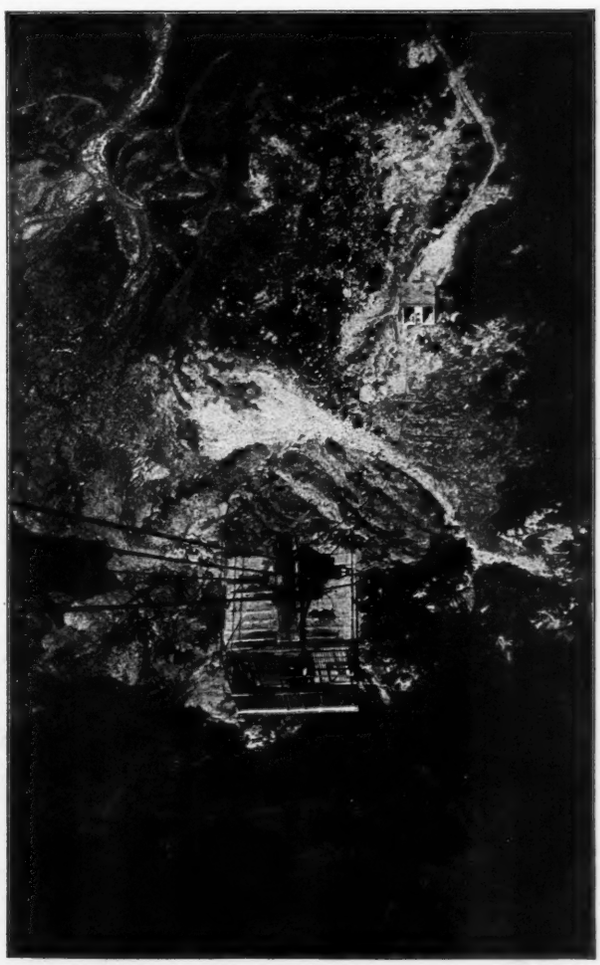
PROFILE OF CABLEWAY—VERTICAL PROJECTION, 1,377 FEET; HORIZONTAL PROJECTION, 1,197 FEET.

An accompanying diagram gives a profile of the Wetterhorn cableway, showing the location of the upper and lower stations. The vertical height between these terminals, as previously stated, is 1,377 feet; the horizontal distance is 1,197 feet. Two cables for a hoist are represented in the illustration by a single line. The upper line represents the catenary when the cables are free; while the middle line shows the form of the curve when the car is half-way between stations. The dotted line shows the envelope of the curves which the cables take when the car passes on its queer journey up and down.

The trolley cables have a diameter of about two inches, and have a weight of



General View of the Cableway from the Side.



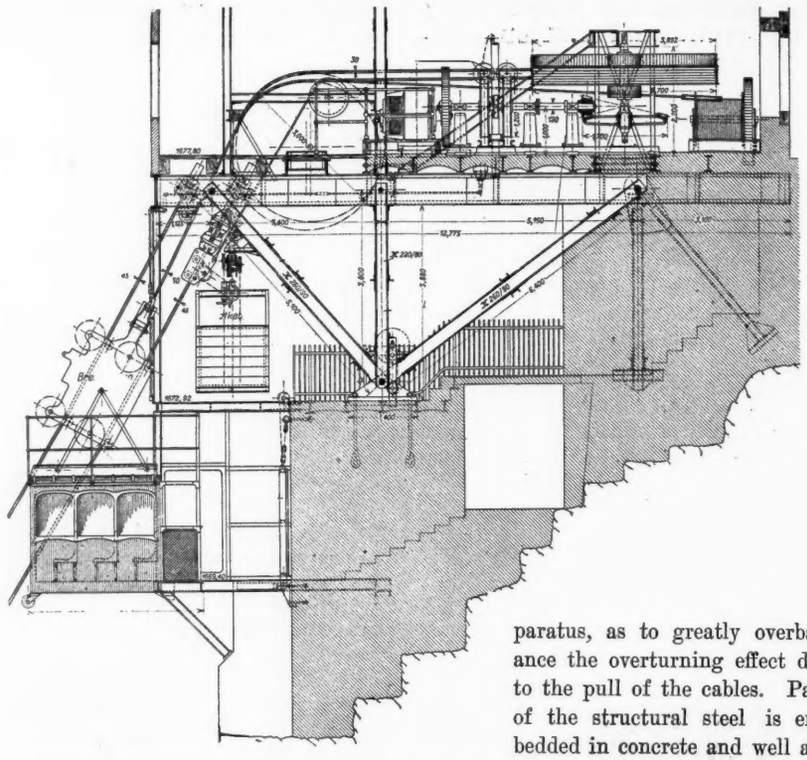
View from the Upper to the Lower Station.

THE WETTERHORN CABLE ROAD OF THE GRINDELWALD GLACIER.

7.4 pounds per running foot, and consist of ninety-six wires in five layers. While the maximum tensile strength required is exactly 13.8 long tons, tests show that the actual tensile strength is 154.3 long tons, thus giving a factor of safety of eleven.

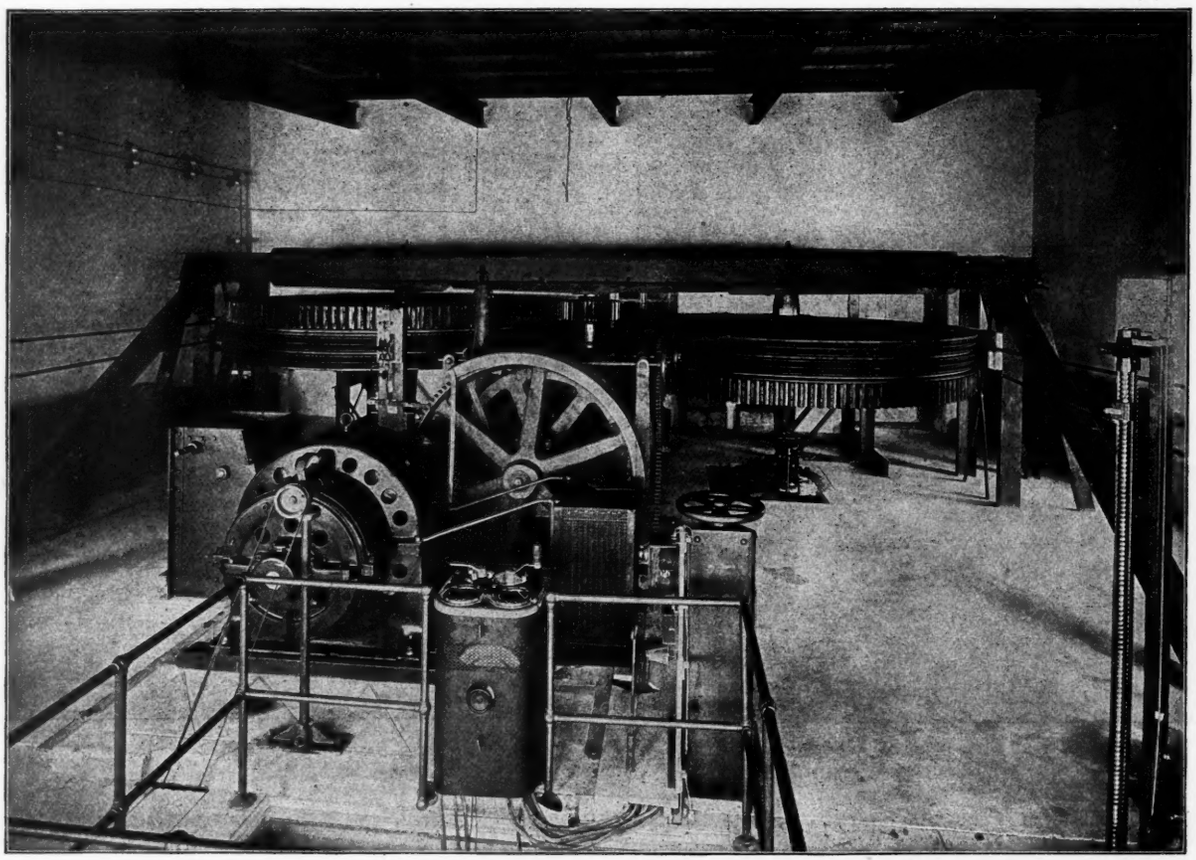
The hoisting cables have a diameter of one-and-one-eighth inches, and are composed of ninety wires in six layers. The normal tension required for each cable is 2.5 long tons, while the actual strength is 43.75 long tons, which means a factor of safety of 17.5. The two hoisting cables of each car are 5.4 feet apart. While the fastenings of the hoisting cables on the trolley have no special features, much study was devoted to the design of the anchor fastenings of the trolley cables.

The diagram herewith shows a section of the upper station and the design of this anchorage. The upsetting of the cable is done in the usual way, while the grip rests on sets of segment roller bearings, to accommodate the various positions of the cable when the car is in motion. The distance between a pair of trolley cables is 2.9 feet; that between the cableways is twenty-six feet.



VERTICAL SECTION THROUGH UPPER STATION.

As the upper station is, of necessity, on a steep mountain slope, a heavy concrete foundation in step-form is provided, and so arranged, with the structural steel of the building housing the hoisting apparatus, as to greatly overbalance the overturning effect due to the pull of the cables. Part of the structural steel is embedded in concrete and well anchored; the remainder rests on an inverted triangle, the apex serving as a pivoting point. To further insure stability, most of the ma-

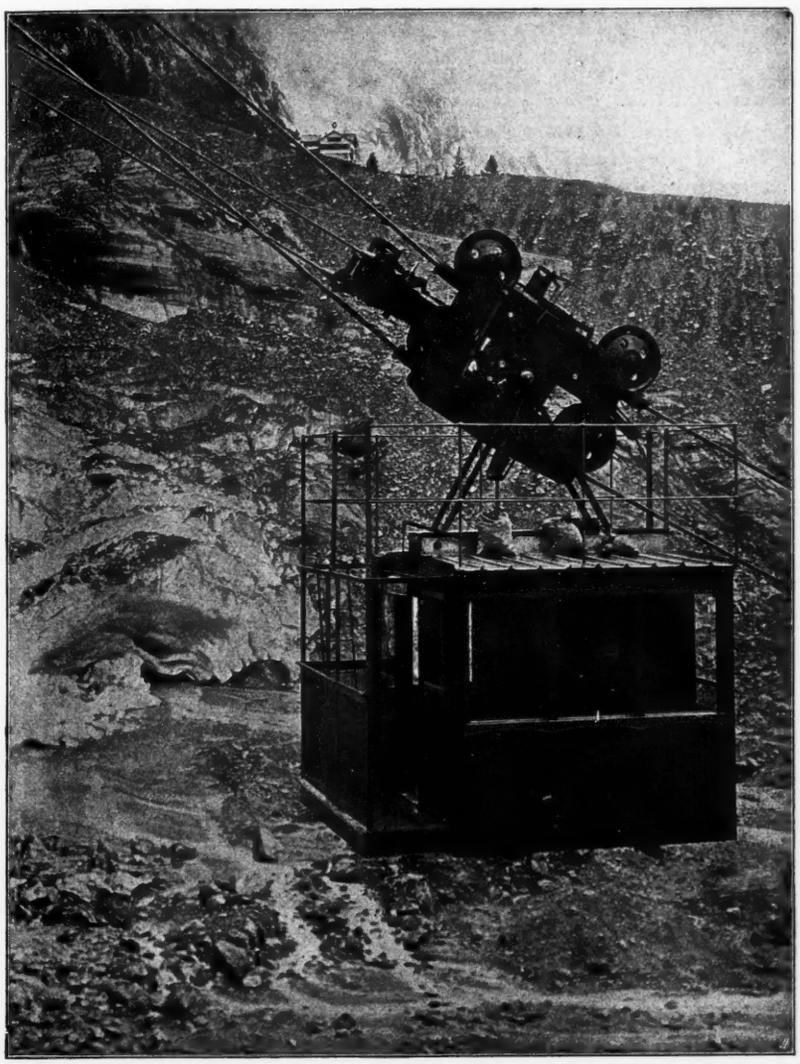


VIEW OF THE HOISTING MACHINERY IN THE UPPER STATION.

chinery is placed in the rear of the hoisting room. In addition to this the floor in the rear, and the rear wall itself, are made exceptionally heavy, while the remainder of the floor and walls are of light design.

The hoisting apparatus, as shown in an accompanying view, consists of a forty-five-horsepower motor, operating, by means of gears, two sheaves having six grooves, 12.13 feet in diameter, thus giving each cable three grooves. The two hoisting cables of each car are guided to the winding drum by guide sheaves, 9.8 feet in diameter, set in an inclined position. The cable is not wrapped completely around one drum, instead it laps half the circumference of both.

By a special arrangement of switches the driving motor serves as a magnetic brake, which comes into action in case the current supply is cut off; should the motor overspeed, rheostats are cut in automatically; and finally, to prevent the car from entering too far into the station, an automatic brake device is applied. This device is provided with manual control, in connection with speed and elevation indicators. In addition to the automatic brake there is a separate hand brake, whose sole purpose is to bring the car into gradual approach to the platform. Thirteen feet from the platform the current is cut off automatically from the motor, and the rheostats are thrown in and gradually cut out in steps.



VIEW OF CAR AND TROLLEY CARRIAGE.

In order to have the trolley-cable tension equally distributed, the lower ends of the cables of each road are connected by a Gall's chain, running over wheels, to a traverse, from which a weight of 18.5 long tons is suspended into a pit. The traverse contains three spurs, over which the chain leads. The two outside ones are free, while the middle one is fixed and set to accommodate slight variations in sag, due to the expansion, which have occurred during the early period of operation. After conditions have become normal, the weight will keep the sag uniform. To prevent the chain from slipping through the guide, in case of a break in a single cable, two fixed points are provided; in such a case the car can continue on a single cable, which, it will be remembered, has a factor of safety of eleven.

In a view herewith is shown the car or cage, and the method of suspension from a four-wheeled trolley carriage. It is made in two compartments, separated by a slot open on one side, to accommodate the cable as the car travels. This slot had to occupy the entire length of the car, because the steepest gradient in the cable is at the upper end, being 200 per cent. The car is 10.5 feet wide and 8.2 feet long. At one end is a platform 2.7 feet wide for the operator. The car is large enough to accommodate sixteen persons, eight seated and eight standing. The frame is of structural steel; the interior is finished in wood, and the outside with corrugated iron. Above the seats abundant window space is provided for observation purposes. The top of the car is provided with a railing, so that in case of emergency, the operator can make a safe inspection of the trolley carriage. The car with its carriage weighs 4.1 long tons; to this must be added 1.275 long tons, the weight of the complement of sixteen passengers and operator. The trolley carriage is made of steel and wrought-iron throughout, no cast-iron being used.

Probably one of the most difficult propositions on the whole undertaking was to provide the trolley carriage with an effective brake device, so that in case one or both hoisting cables should part, the car could automatically come to a standstill. The principle is that each cable runs through a split conical feather which fits in a sleeve. Two strong blade springs resting against the cones, when tipped, force the feathers against the cables. In case the brake has been applied during the run, it can be released from the top of the car by means of a special tool. It may be stated here that the cable manufacturer was unwilling to give any guarantee for cables subjected to such conditions. The builders of this cable road, L. von Roll's Iron Works, Gerlafingen, Switzerland, made tests with this braking device, showing that the car comes to a standstill within ten inches after the brake has been tipped, although the cables are greased. Considering this short breaking distance, it must be borne in mind

that the sag of the cable counteracts the strain due to the sudden application of the brake, thus acting as a buffer. The braking device, as well as the rest of the equipment, was for several days rigidly subjected to governmental tests before being turned over for public service.

Current for operating the hoist is supplied by a power house at Grindelwald, over a single-phase line at 2,400 volts. In the lower station is a motor-generator set to convert the supply into direct current at 800 volts, for the forty-five-horsepower, shunt-wound, hoisting motor. For emergency cases there is installed a seventy-four-ampere-hour storage battery capable of furnishing energy for twenty-five trips. Should both sources of current supply fail the winding drum can be manually operated for bringing the cars to the stations.

In addition to these precautions, in case the brake should become jammed, there is provided for each hoist an emergency car, the windlass of which is operated by a single-phase eight-horsepower motor, or by hand. This car is guided on the lower of the two cables, and has a capacity of four or five passengers. Telautograph communication is maintained between the cars and the upper station, while between the upper and lower stations, independent telephone service is established.

The many and various emergency devices employed were installed to gain the confidence of the traveling public for an entirely new departure in passenger transportation. With the exception of the electrical equipment supplied by Brown, Boveri & Company, of Baden, the installation was furnished and erected by L. von Roll's Eisenwerke, Gerlafingen, both of Switzerland.

Electric Lights Better Than Police Patrol.

The town of Xenia, Ohio, has reduced its police force by one-half as the result of better lighting service. Instead of five patrolmen and a chief, the city will now have to get along with the chief and two patrolmen.

The City Council, at a recent meeting, decreed that electric lights were more valuable to the town than patrolmen, and as there was not enough money for both necessities, the Council compromised and took the lights. The new rule went into effect July 1. Xenia is a dry town and is reducing its expenses to the minimum.

Electrical Exports for May.

Electrical exports from the United States for the month of May show improvement over April and are better than for the same month a year ago. Trade is evidently picking up again, although not yet back to the figures of the earlier months. Prospects are, however, quite good.

As prepared by the United States Department of Commerce and Labor, the official statistics on the electrical exports are as follows:

	May, 1909.	April, 1909.	May, 1908.
Appliances	539,424	490,483	464,114
Machinery	479,951	489,026	469,088
	1,019,375	979,509	933,202

A list of the principal countries to which electrical products were exported during May, 1909, with the value of these exports, is given below:

Exported to—	—Electrical— Appliances.	Machinery.
United Kingdom	40,585	41,303
Belgium	3,838	26,542
France	2,299	3,229
Germany	17,352	16,307
Other Europe	6,581	119,673
British North America	171,970	69,196
Central American States and British Honduras	19,331	32,850
Mexico	56,802	7,307
Cuba	22,745	1,158
Other West Indies and Bermuda	2,938	11,041
Argentina	21,197	25,925
Brazil	91,354	4,208
Other South America	18,299	309
Chinese Empire	.....	981
British East Indies	.....	84,356
Hongkong	.....	30,740
Japan	21,905	12,626
British Australasia	2,318	2,579
Philippine Islands	32,608	7,350
Other Asia and Oceanica	.....	17,834
British Africa	3,373	53
Other countries	3,929	.....

Western Electric's Business.

Preliminary returns for May show that the business of the Western Electric Company is running at the rate of between $46,000,000 and $48,000,000 per annum. This would make the gross returns for the first half of the company's fiscal year ended with May, exhibit business of close to $23,000,000, or an average of nearly $4,000,000 a month.

April sales were fifty per cent larger than in April, 1908, and the sales in May were seventy per cent greater than the corresponding month in the preceding year.

Electrical Development in English Mines.

A great awakening to the advantages of the use of electricity in coal mines is taking place in the Lancashire mines in England, and about a dozen of the foremost companies have placed orders for electrical equipment to the aggregate value of upward of a million and a quarter dollars.

The New Point of View.

The state of Massachusetts is beginning to take a somewhat more liberal view of the legitimate necessities for which corporations may increase their capitalization. Governor Draper has signed an amendment to the street-railway laws of the state which gives to traction companies a latitude in capitalization that they have never enjoyed before. The amendment authorizes street railways, with the approval of the railroad commissioners, to issue new securities for the purpose of providing working capital. Hitherto Massachusetts has rigidly adhered to the principle that every dollar of capitalization must represent at least $1 of property.

The amendment does not involve the abandonment of the former safeguards, but it is supplementary to it, and recognizes the fact that, with street railways at least, the margin of profit above charges is so narrow that it is impossible to accumulate out of surplus earnings a fund for working capital. Of the eighty-two street railways in the state forty-three, or fifty-two per cent, do not even pay dividends at present. The new law authorizes street railways, with the approval of the railroad commissioners, to issue up to five per cent of their stock in new stock for working capital or to issue such amount of bonds as shall not impair the security of bonds outstanding at the time application is made.

About eighty per cent of the street-railway traffic of Massachusetts is handled by the Boston Elevated, Boston & Northern, Old Colony, Worcester Consolidated and Springfield Street Railway companies. These companies regularly require from seven to ten per cent of their capital in cash or materials. The new law will make it possible for the street railways of the state to avoid the necessity of creating floating debt in order to carry on the ordinary conduct of their business by giving them a reasonably adequate working capital.

Electrical Projects in Santos, Brazil.

Consul D. P. De Young reports that a new company, composed of Americans and Brazilians, is negotiating for a franchise to operate a line of street cars in Santos, to be constructed up Monte Serrate and to the beach, and that Doctor Ferreira dos Santos, chief of the Bureau of Telegraphy, is negotiating for the installation of a wireless station on Monte Serrate, overlooking both sea and city.

Chicago Electric Club.

Following the regular Wednesday noon luncheon held on June 30 in the Grill Room of the Chicago Automobile Club, the Chicago Electric Club listened to a very excellent address on "Some Phases of Steam-Railroad Electrification, Particularly Comparing Chicago and New York as Possible Future Centers," by E. N. Lake, division engineer of the Board of Supervising Engineers, Chicago Traction.

Mr. Lake's address related to three aspects of the electrification problem, namely, growth, centers and systems. In taking up the first of these the speaker traced the rapid development of electric traction within the last score of years. In the Baltimore & Ohio tunnel was the first example where the electric locomotive demonstrated its ability to handle heavy traffic. Since 1890 the application of electricity to street railways has brought about an extension of city traction systems to somewhat over four times the mileage. In 1890 electric railways constituted less than one-sixth of the street railways of the country. In 1907 they formed about ninety-nine per cent. After the urban development of electric street-railway systems these were extended into suburban districts. Following the growth of suburban lines, came the development of interurban systems connecting nearby cities and towns. The fourth stage of this development, viz., that of electrification of transcontinental systems is at hand.

As the traction electrification has extended from urban lines outward, so now railroad electrification is about to be extended from terminal cities, over the entire line. A case in point is that of the New York, New Haven & Hartford Railway, which has its New York terminal already electrified, and is now contemplating electrification of its Boston terminal, the two cities to be ultimately connected by electric service entirely. Mr. Lake predicted great activity in the next ten years in the electrification of trunk lines. New York city is now the center of electrification in the East. Chicago ought to be that in the West. On drawing circles of some 400 miles radius about each of these cities it is found that in the New York zone there are fourteen states, in the Chicago zone nine states. The land area of the Chicago zone is about twice that of the New York zone; both these zones contain two-thirds of the entire population of the United States. From these facts Mr. Lake feels certain that Chicago is bound to become a great center of electrified railroads. It already is the greatest railroad center, as within its zone there is about one-third of the country's railroad mileage as against one-sixth in the New York zone.

The railroad-electrification problem consists of the substitution of three electrical elements for the locomotive equipment. These are: A generating station, a distributing system, and a locomotive system. Steam-railroad men are inclined to overrate the effect of electrification upon the equipment of steam locomotives. The valuation of the entire railroad property in the country on June 30, 1908, gave a total of $13,000,000,000. The total number of steam locomotives was 55,000; their average value was $11,500 each, thus making a percentage value of the locomotives of only 4.86 of the total. The annual renewal of steam locomotives is now in excess of this figure, so that the gradual substitution of electric locomotives does not mean the wholesale scrapping of the steam equipment; in fact, it is doubtful whether a larger number of steam locomotives would be turned to the scrap pile than are now.

There are now being tried out in New York city, side by side and under similar conditions, the two apparently most promising systems of electrification. In the case of the St. Clair and the Detroit River tunnels a similar comparison of the single-phase overhead and of the direct-current third-rail systems will be made. Each system has already demonstrated not only its feasibility, but its economy and operating advantages. The result of the comparative performances is being watched, and the system best adapted for the use of long trunk lines will be discovered very soon.

At the meeting of the Chicago Electric Club, held on Wednesday noon, July 7, A. A. Gray, managing editor of the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN, gave a condensed review of the recent annual convention of the American Institute of Electrical Engineers at the Thousand Islands, Frontenac, N. Y. He abstracted briefly the papers that were presented and spoke enthusiastically of the excellent arrangement of the technical sessions and entertainment features, the cordiality that was everywhere manifested, and the general good time enjoyed by all who attended. C. A. S. Howlett, president of the club, added his impressions of the conflicting papers relating to the use of flywheels for motors.

Announcement was made by John J. Schayer, chairman of the entertainment committee, that arrangements for the first annual Electric Club picnic were practically completed. It will be held at Michigan City, Ind., on Saturday, July 17. An entire deck on the S. S. Theodore Roosevelt will be reserved for the club. The steamer will leave the dock at the Clark Street bridge, Chicago, at 10 a. m. Returning, boats will leave Michigan City at 4:20 p. m., arriving in Chicago at 7 p. m., and also at 7:45 p. m., arriving in Chicago at 10:15 p. m. The fare for the round trip is $1.50, which includes also a good dinner at Michigan City at 1 p. m., and admission to the amusement park, concessions, etc. There is an excellent bathing beach and good facilities for baseball and other athletic sports. The entries for the field sports are being received by O. B. Duncan, chairman of the athletic committee. Ladies are especially invited to the picnic.

Navy Department Supplies.

The Bureau of Supplies and Accounts, Navy Department, Washington, D. C., will open bids on July 20 for the following electrical material: Miscellaneous connection boxes, 20,000 carbon arc lamps, miscellaneous knife switches, switch fittings and rubber-covered wire, for delivery at Brooklyn, N. Y.; for miscellaneous conduit, elbows, outlets and bushings and miscellaneous wire, for delivery at Pensacola, Fla.; miscellaneous rheostats and starting panels, for delivery at Annapolis, Md.; for three transformers, for delivery at Boston, Mass.

Bids will be opened on August 3 for two electric jib cranes, for delivery at Mare Island, Cal.

Bids will be opened on August 10 for one armature-binding and field-coil-binding machine, and one motor-driven derrick, for delivery at Puget Sound, Wash.

Technical Book Publishing Consolidation.

The book departments of the McGraw Publishing Company and the Hill Publishing Company have been consolidated under the corporate name of the McGraw-Hill Book Company, with offices at 239 West Thirty-ninth Street, New York, N. Y. The officers are John A. Hill, president; James H. McGraw, vice-president; Edward Caldwell, treasurer; Martin M. Foss, secretary. The consolidation is an important move for the making and selling of technical books. The company will also make a feature of the prompt importation of any foreign technical book not in stock.

Electrical Notes From Great Britain.

By Our British Correspondent.

The city of Calcutta is supplied with electricity by an English company—the Calcutta Electric Supply Corporation, Limited—and this company is doing a rapidly increasing business, the demand for energy for lighting and power, the latter especially, including electric fan purposes, being reported as very gratifying. The company's license covers an area of seventeen-and-one-half miles, north to south, and thirteen miles, east to west, but much of this area is as yet undeveloped. The engineer reports a large demand for factory power, and he further considers that a ring main should be laid round the city giving supply to the substations. Though this plan is still under consideration the board admits that it has no alternative but to adopt the proposition, and it recognizes that it must extend not merely in order to carry out the company's statutory obligations, but in order also to prevent any rival entering the district.

Gradually a spirit of greater hopefulness seems to be coming over even men connected with electrical industry in England. T. O. Callender, managing director of the big cable manufacturing company which bears his name, in indulging in reflections concerning the past and in guarded prophecy as to the future, showed that the cable business, just as the dynamo and turbine lines, has been greatly affected by the metallic-filament lamp—the electricity suppliers having found their mains sufficient to deal with the demand. But, he said, they looked on that lamp as the best thing they could have, because they believed that next year, or at least the year after, there would be a big boom in electrical supply, due to the large extension coming from the new lamp, because mains would be carried into districts which hitherto had been considered out of the region of electric supply. Mr. Callender reports a distinct improvement in electric cable trade—demands from old customers are increasing, and there is a decided move toward extensions elsewhere. Other leading men in British electrical industry have also been voicing the view that there are evidences of real improvement.

As bearing upon the question of competition between gas and electricity, of which so much is heard in England, it is interesting to observe that in the city of Bradford, where both the electricity and gas departments are owned and operated by the municipality, though run as separate departments, the gas committee has come forward with a proposition which is intended to pave the way for a compromise. It advises that for the present no canvassing of the public should be done by either the gas or the electricity departments, one department against another, in any district where there are now gas mains or electricity cables, but that where applications are received for a supply of either electricity or gas, the department shall be at liberty to canvass for customers, on giving notice of such intention to the other department; neither of the foregoing proposals to "affect canvassing for power purposes where the other department is not affected." While there is undoubtedly room for co-operation rather than such severe rivalry between the apostles of the two systems, it seems unlikely that the above proposal will be acceptable to an electrical department with a progressive mind at its head, but it may serve as a basis for a discussion of the matter.

Once again efforts are being made to provide organizations which shall more adequately represent the various electrical interests of the United Kingdom. The National Electrical Manufacturers' Association, with its forty or fifty members, has not attracted the larger electrical manufacturing concerns to its membership, and the importing element has been too strong to make outsiders consider it a desirable body with which to become associated. Changes that have recently been made, together with the present efforts to explode certain wrong ideas that have become prevalent, are hoped to strengthen the body by bringing in several makers of large plant—an element that has too long been practically absent. Another movement that is on foot is headed by Sir William Preece, who has just expressed himself on the desirability that exists for forming a National Electrical Industrial Association which, when it speaks, shall lead Parliament and the world to believe that it represents everybody and everything electrical.

H. Mozley, the tramway manager of Burnley, in his annual report just received, records his experience in attempting to obtain for one of his routes a more economical car than the four-motor equipments. He had an experimental car running for more than twelve months using first of all Simpson and Park radial trucks. These proved unsatisfactory and were abandoned, and the trucks were converted to simple pony trucks, but with a new arrangement of the carrying body springs and king pins. The whole weight of the body is carried on the driving axle, thus increasing the adhesion compared with the Brill maximum trucks under the double-deck cars, and the king pin by being placed in the center of the axle greatly reduces the work of the pony wheels, which act as guides to the truck. Mr. Mozley says that so far the result is very satisfactory. The tire sections after nine months' service are practically perfect, and the car runs smoothly and noiselessly compared with the four-motor equipments. There being only two motors, and the truck being lighter, there is a saving of about three tons in dead weight; moreover, the motors are four-turn and thirty-seven horsepower as against five-turn and twenty-eight horsepower, which means about nine per cent improvement in speed. The new type uses twenty per cent less energy. It is believed that the new type of truck and two-motors may be applied to the old type of body, as the weights are nearly alike, and Mr. Mozley suggests converting one four-motor car with the view to converting the remainder if successful. He says that the new type of car is ideal for relief and shuttle services on the main line.

At the moment of writing the annual convention of the Incorporated Municipal Electrical Association is in full swing at Manchester, the electrical engineer of which city, S. L. Pearce, is president. One looks in the inaugural address of this body less for novelty and originality than for a summary of the more important matters of the moment bearing on the commercial and technical sides of municipal electricity supply. Mr. Pearce's address touched briefly on a variety of topics that have recently been under discussion. He alluded quite early to the importance of municipal departments attending to such matters as depreciation and antiquation before distributing profits among the ratepayers, in order to insure financial stability. The rapid adoption of

metallic-filament lamps which has affected the undertakings of so many municipal engineers during the past year, of course came in for attention, as did also some of the questions which arise as practical issues from its adoption. There is at present a slump in output of energy, but from this there is bound to come a reaction, as consumers recognize the advantages of the lamps. Raising charges for energy is to be deprecated at any time, but it is a particularly questionable policy just now. Mr. Pearce believes that the worst of the check has been experienced, and he advocates marking time in the matter of price reductions, even though revenues should suffer for the time. "Nothing," he said, "should be done to arrest an increase in new connections just when they are most urgently wanted." The present cost of wiring practically precludes the oncoming of the small consumer, and the president holds that, where æsthetic considerations do not enter in, encouragement should be given to the use of "flexible" and other surface wiring systems, such as are now so much to the fore, but such cheapening must not involve, in any shape or form, a lowering of the standard of safety. Later in his address, Mr. Pearce remarked that it was chiefly to the large power users that, in the future, supply undertakings will have to look for increased sales and substantial growth. The status of the municipal electrical engineer, a subject of particular interest just now for several reasons, was another point briefly referred to. There was never a time when it was more necessary for the municipal engineer to uphold his position in connection with electrical undertakings. Pushfulness, he admits, the engineer may lack, but it cannot be said that any engineer worthy of the name lacks commercial knowledge and aptitude, and as in the administration of electricity departments science and technical knowledge enter in at every point and largely determine all questions of high policy, the engineer must be referred to in the end as the controlling officer acting under and subject to the municipal committee.

The first paper to occupy the attention of the convention was by Councilor A. Sinclair, and it dealt with the subject of "Cheap Units." Under certain circumstances 6d per unit may be cheap, while in others even 1d may be dear. The author endeavored to analyze the various classes of supply, thus arriving at something like a basis from which to calculate on its merits the selling price of each class of unit. Sufficiently low prices could be charged to make energy from a public supply undertaking attractive, and still leave a fair margin of profit. Good business was often lost by trying to obtain too high prices.

E. E. Hoadley, electrical engineer of Maidstone, introduced "The Influence of Metallic-Filament Lamps on the Electrical Industry, and on Street Lighting," touching the first part of the subject very briefly, leaving others to speak of the particular effect on each manufacturing and selling branch of the electrical industry, while he devoted the greater part of his attention to the effect of the lamps on the supply stations. He urged all station engineers to unite in trying to obtain what he considered the necessary powers to enable them to utilize to the full the immense power put into their hands by this epoch-marking invention, and by themselves getting into personal contact with their consumers, putting before them the great advantages of more light for the same money, instead of the same light for less money.

"Modern Cable Systems" was the title of E. M. Hollingsworth's paper, and underground cables of electricity undertakings were chiefly the subject discussed. The author said it was within the bounds of possibility that other and cheaper materials than those used at present for the manufacture of cables might be found suitable, but on the question of reliability, combined with cost, it hardly seemed possible to improve the methods now usually adopted for protecting the cables underground. The probable use of aluminum was touched upon, after which Mr. Hollingsworth discussed rubber insulation, vulcanized bitumen insulation, paper insulation, systems of laying cables, "direct system," "solid" system, "draw-in" system, subways, and the value of overhead conductors for supplying isolated districts.

An excellent paper by Alfred Blackman, borough electrical engineer of Sunderland, set down certain definite opinions held by the author on "Steam Turbines: From the User's Point of View," his object being to promote discussion. "Notes on Condensing and Water-Cooling Plants," by E. Lunn, followed.

The members present at the meetings at Manchester and Liverpool from June 21 to 25 had the opportunity of visiting a number of leading generating stations and works of manufacturers, and a visit to the Mauretania with its unique electrical equipment was one of the most attractive features.

It is reported in some quarters that the North Eastern Railway is about to proceed with the long-expected extension of its electric suburban system. The proposal is said to be for equipping the lines between Newcastle, South Shields and Sunderland for direct-current working as employed on the present electric sections. It was said that the North Eastern, like some other English railway systems, was waiting to watch the experience of the London and Brighton Company's single-phase system before proceeding, but so far as practical working is concerned there has not been time to admit of any opinion being based upon that.

ALBERT H. BRIDGE.

London, June 26, 1909.

Telephones Open Up National Forests.

During the present fiscal year $600,000 will be spent for the construction of roads, trails, telephone lines and other permanent improvements on the national forests. Congress has appropriated the same amount for this purpose for the fiscal year of 1909-10.

Trails are being constructed along routes which give the best control of the areas to be patrolled by the forest rangers. In many districts telephone lines have been built between the supervisor's office and ranger headquarters and to prominent peaks which are used for lookout stations to observe fires. These telephone lines and trail systems are of vital importance, resulting in the remarkably small area burned over since forests have been under government supervision.

Bulk Supply in Colorado.

The Northern Colorado Power Company has retired from the field in the Greeley and Fort Morgan districts as a retail distributor of electric current. The Home Gas and Electric Company, of Greeley, Colo., will in future buy the current from the Northern and act as the distributing agent. The Home Company will also begin at once the extension of its lines east toward Fort Morgan, and will serve the entire territory of farm land between here and that city. The wires will also be extended north practically to Cheyenne. Just how closely the two companies may be allied is not known, but it is considered to be merely the relation of a jobber and merchant, the Northern Company making the "juice," selling at wholesale price to the Home Company, and the latter selling it again at retail and looking after the small detail work.

High-Speed Conduit Construction.

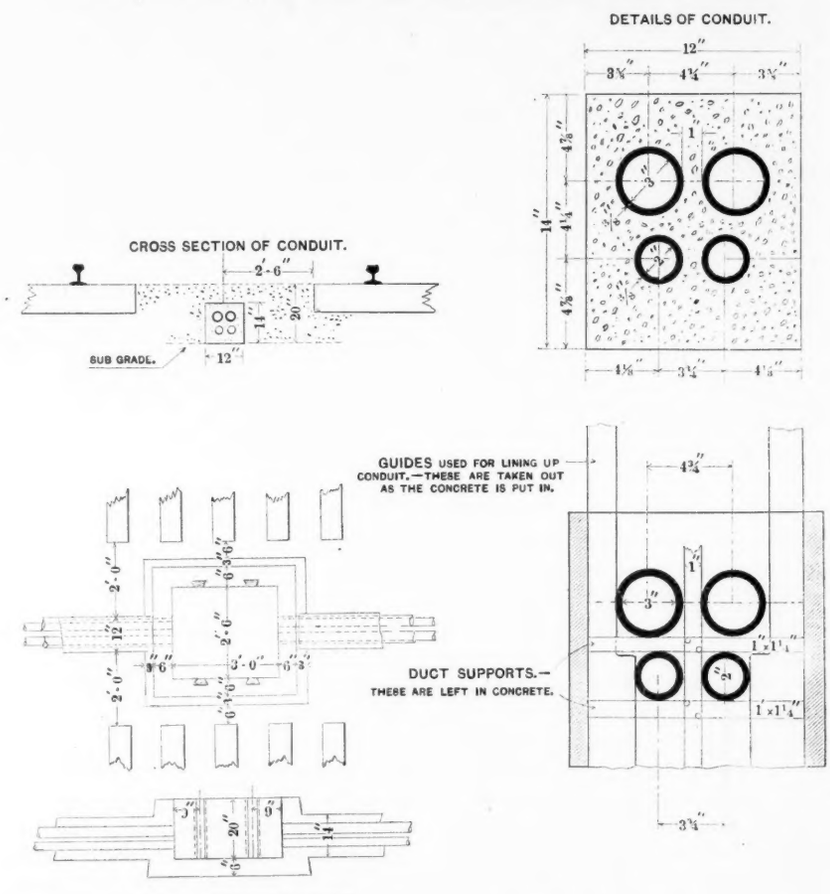
In railway signaling the reliability of the line is an essential feature if continuity of service is to be secured and insurance against the attacks of inclement weather is the primary consideration if this condition is to be obtained. In line with modern methods some of the more progressive railroads are establishing conduit systems for their signal lines, thus eliminating the possibilities of interruptions to service, a striking example of which occurred at the time of the inauguration of President Taft last March when telephone and telegraph wires went down in every direction, and trains were stalled on many roads leading into Washington, due to the failure of the overhead signal lines.

The New York, New Haven & Hartford Railroad has just installed on the Harlem River branch, over a stretch of its right-of-way twelve miles long between New Rochelle, N. Y., and the Harlem River, a four-duct conduit system which has been laid in by G. M. Gest, electric subway contractor, under his patented method of fibre conduit installation. The accompanying illustrations tell the story, and the following description will be merely to amplify the various features indicated in the views printed herewith.

One of the main features of this method of conduit construction lies in the employment of a construction train which carries all of the workmen and materials of construction, absolutely eliminating any littering of the roadbed with implements or material either before or after construction. A locomotive and a train of seven flat cars and a box car carrying cement, gravel or crushed stone, sand, water, conduit and forms, are taken along the right-of-way, and from 1,500 to 2,500 feet of trench are installed complete each working day. This is an important item, as it is quite essential that there be no unnecessary occupancy of the track for construction of this character. In this case the speed which Mr. Gest was able to make was entirely satisfactory to the railroad and did not interfere in any way with the regular movements of the trains.

In laying down this system the ballast between the tracks is shoveled up on to either side of the roadbed, an ordinary trench is excavated, and skilled conduit builders place wooden forms in proper position with their tops true to gauge. Wooden or concrete block spacers are placed at predetermined distances, and the conduit threaded and suspended in position along a predetermined run. At certain distances on each side of the suspended conduit wooden spacing and locking paddles are placed sidewise in the trench, given a right-angled turn so as to bring the conduit true to line laterally, and the cement and concrete poured in. As was noted above, all of the materials are carried on the working train, the cement, sand and gravel being carried to a Ransom mixer on runways from their respective flat cars. Water is siphoned from a water tank carried on one of the

THE WORK TRAIN, SHOWING THE CONCRETE MIXER AND CHUTES.

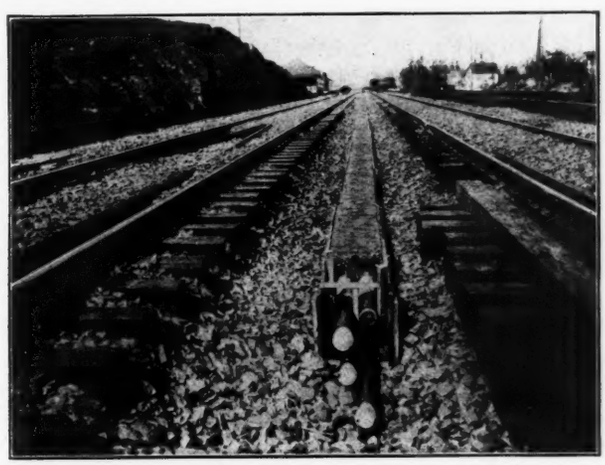

DETAILS OF CONDUIT.
CROSS SECTION OF CONDUIT.
SUB GRADE.
GUIDES USED FOR LINING UP CONDUIT.—THESE ARE TAKEN OUT AS THE CONCRETE IS PUT IN.
DUCT SUPPORTS.—THESE ARE LEFT IN CONCRETE.
PLAN AND SECTION OF MANHOLE

DETAILS OF METHOD OF INSTALLING FIBRE CONDUIT.

cars, and the concrete is delivered from an engine-driven mixer into a sectionalized hopper. From the hopper the concrete is fed into the excavation from two chutes, one placed ahead of the other. The sectionalized hopper makes it convenient to feed into the bottom of the trench from the forward chute, and into the top of the trench from the rearward chute as the train proceeds along the conduit run. As soon as the trench is filled to the top of the forms with concrete the ganging and alining paddles are withdrawn and the concrete allowed to set.

When the concrete is set the side forms are withdrawn and the ballast shoveled in and around the completed structure leaving the roadbed in exactly the same condition as it was before operations were started. In this connection it is to be emphasized that during all the period of construction the profile was absolutely unimpaired and the construction caused no change whatever in the weight or speed of the trains passing.

DUCTS SUSPENDED IN FORMS READY FOR THE CONCRETE.



CONDUIT IN PLACE AND CONCRETE READY FOR REMOVAL OF FORMS.

During construction the manholes were built in at the same time the conduit was laid so that as each run was completed there was no necessity for returning for additional construction or excavation. Where it was necessary to cross a bridge the conduit was brought out into three-inch galvanized iron pipe, run over the bridge truss, with a manhole at each end of the bridge. The conduit used consisted of two two-inch ducts and two three-inch ducts of fibre conduit, manufactured by the Fibre Conduit Company, of Orangeburg, N. Y.

Mr. Gest maintains engineering offices in New York, Cincinnati and Chicago, the latter office in the Monadnock Building, in charge of J. A. Doyle. The work was laid out by E. Gagel, chief engineer of the N. Y., N. H. & H. R. R., C. H. Morrison, signal engineer, and constructed under the direction of I. D. Waterman, division engineer of construction of the Harlem River branch.

Electric Locomotive Headlights.

A singular condition is apparent in Indiana relative to recent legislation concerning the use of electric headlights on locomotives when compared with the situation in Georgia and North Carolina. The Indiana Legislature passed a law empowering the Railroad Commission to compel the use of power or electric headlights if, after careful investigation, the Commission finds them to be more efficient than the oil headlight. Similar legislation was had in South Carolina, where the locomotive engineers are making strenuous efforts to have the law carried out and electric lights installed, while in Indiana the engineers have unanimously condemned the electric headlight and have declared their preference for the ordinary twenty-candlepower oil light. The third conference on the headlight question will be held before the Indiana Commission June 29, and it is fair to presume that if the Commission is guided by the evidence of the engineers there will be no order entered for the compulsory use of electric headlights. The engineers say the light is too intense and prevents their reading the signal lights correctly. S.

Manhattan Elevated Pays $1,582,038 to New York City.

The Manhattan Railway Company, the old elevated railway company of the Interborough-Metropolitan consolidation, has paid the city of New York $1,582,038 in taxes.

The Sensible Way.

Delaware County, Pa., is to be lighted by one big central-station plant. By a vote of the stockholders of the Media Electric Light Company, of Media; the Citizens' Electric Light and Power Company, of Clifton Heights; the Faraday Light Company, of Morton, and the Philadelphia Suburban Electric Light Company, of Lansdowne, these companies have merged into the Delaware County Electric Company, a concern which now practically controls all of the electric-light companies in Delaware County, Pa. It is understood the plans contemplate the erection of a big central plant. The operation of the plants will all be under one management.

The following officers of the Delaware County Electric Company have been elected: President, W. Roger Fronefield, of Media; vice-president, William F. Morris, of Penn Yan; secretary and treasurer, Joseph W. Taylor, of New York; general superintendent and engineer, J. W. Barstow, of New York.

The Indiana Municipal League.

The nineteenth annual meeting of the Indiana Municipal League was held in Lafayette, June 22, 23 and 24. The attendance was the best in the history of the association. Among the numerous questions of interest to municipalities that were considered and discussed, the question of municipal ownership of public utilities provoked the most extensive and warmest discussion.

The next meeting will be held in Richmond in December and the program committee was instructed to make municipal ownership the most prominent subject for the first day's discussion. S.

The Ohio Electric Light Association.

The Ohio Electric Light Association will hold its fifteenth annual convention on Tuesday, Wednesday and Thursday of next week, July 13, 14 and 15, at the Boody House, Toledo, Ohio, where the most successful previous meetings of the association have been held.

The Ohio Electric Light Association has an enviable reputation among electrical men, and present indications are not wanting that this year's convention will at least be up to the high standard previously attained in former conventions.

The convention this year has been arranged one month earlier than usual in order to avoid the rush season of August.

In order to afford ample time for discussions the number of papers has been limited in amount but not in quality or interest. The following is the list of papers to be presented:

"Residential Lighting," "The Supplying of Electric Current to Other Towns from a Centrally Located Station," "Engine-Room Management," "The Commercial Organization of Electric Lighting Companies and Their Relation to the Public," "Boiler-Room Economy," "Factors to be Considered in Making Street Lighting Contracts," "Plans to be Followed in Supplying Lamps to Consumers," "The Titanium Arc Lamp" and "Tungsten Lamp Experience." Upon some of these topics more than one paper will be presented.

A handsome souvenir programme is being prepared by the association, and will be distributed at the convention. The following is a list of the projected entertainments, the final arrangements for which will be found in the programme:

Tuesday—Auto ride for the ladies; trip to Casino, with 6 o'clock dinner and theatre party for all. Wednesday—Trip to Fort Meigs for the ladies; trip to Toledo Beach, with frog-leg dinner and ball for all. Thursday Afternoon—Trip to Cedar Point, Ohio, with banquet, lagoon ride and ball in the evening. Transportation in the city and to Cedar Point, and the dinners, banquets, rides, balls and all other features of the entertainment will be free to all attending.

A large exhibit room has been arranged in the Hotel Boody for the free use of exhibitors, and an ample supply of single-phase, 115 and 230-volt sixty-cycle current will be available. If the demand justifies the light company will supply three-phase current at the same voltages.

Hotel rates at the Boody for the convention will be: European plan, $1 to $2.50 per day; American plan, $2.50 to $5 per day. However, the convention furnishes the evening meals of Tuesday, Wednesday and Thursday. Reservations for rooms should be made directly with the Boody House Company.

The National Electrical Contractors' Association.

The annual meeting of the National Electrical Contractors' Association will be held at Toledo, Ohio, July 21, 22 and 23. Hotel headquarters will be established in the Boody House, the meetings being held in the Chamber of Commerce rooms.

On July 21 an open meeting will be held at the Chamber of Commerce at 10 a. m. and a business meeting at 2 p. m. On July 22 an open meeting will be held at the Chamber of Commerce rooms at 10 a. m., a ladies' trolley ride at 10:30 a. m., a business meeting at 2 p. m., the men's banquet in the Boody House banquet hall at 8 p. m. and the ladies' banquet in the Boody House parlor at 8 p. m.

On July 23 there will be an all-day outing at Sugar Island, leaving at 9 a. m. and returning leaving the island at 5:30 p. m.

It is expected that this meeting will be one of the most successful in the history of the organization. The open meetings will be especially interesting, the following speakers having been officially announced:

W. H. Blood, Jr., president of the National Conference on Standard Wiring Rules, will deliver an address on "The National Electric Code and the Relations of the Contractor to the Central Station."

C. S. Elliott, "Illuminating Engineering in the Contracting Field."

George C. Nimmons, "Relations of the Contractor to the Architect."

James R. Strong, "The National Electrical Contractors' Association."

It is expected that there will be two other speakers on timely topics.

The convention will be opened by M. W. Hansen, of Toledo, the chairman of the local entertainment committee, and the delegates will be welcomed by Mayor Whitlock of Toledo and President Millner of the Toledo Chamber of Commerce.

The ladies' trolley ride will be one of the features of the entertainment, covering a trip up and down the Maumee Valley, luncheon being served at the beach.

The outing on July 23 will be full of interesting features and there will be a baseball game between eastern and western contractors. James R. Strong of New York will be captain of the eastern team and E. McCleary of Detroit will be captain of the western team.

"Exide" Meeting at Dayton, Ohio.

The Dayton Lighting Company extended invitations to an illustrated lecture given under the auspices of the Electric Storage Battery Company, of Philadelphia, on Tuesday, June 22, in the auditorium of the Y. M. C. A. Building, Dayton, Ohio.

The meeting was opened by F. M. Tait, general manager of the Dayton Lighting Company. He spoke of the popularity of the electric vehicle in Cleveland, Buffalo, Chicago and other cities and stated that the object of the meeting was to arouse public interest in this type of vehicle which Dayton, up to this time, had neglected.

H. M. Beck, engineer of the operating department of the Electric Storage Battery Company, delivered the principal address, touching briefly on the history and development of the Exide battery and covering very fully and clearly all points regarding the operation of these well-known batteries.

The address, illustrated with lantern slides, was greatly appreciated by an audience of about 100, a number of whom took part in the discussion which followed the reading of Mr. Beck's paper. The meeting aroused considerable interest in the electric vehicle and in the potentialities for its successful exploitation in Dayton, and gave a much clearer understanding of the subject to the electrical engineers, garage men and vehicle owners, who were present, than they had hitherto possesed.

Approve Issue of Bonds.

On June 28, 1909, a general meeting of the stockholders of the New Orleans Railway and Light Company was held at the offices of the company, No. 317 Baronne Street, in New Orleans, La., for the purpose of considering the proposition submitted to them by the directors, in accordance with the provisions of the charter, of authorizing the issuance of $50,00,000 five per cent forty-year first and refunding mortgage bonds, with the following result: Out of a total of 300,000 shares, preferred and common, entitled to vote, there were cast 200,524 shares, 182,490 shares voted in favor of the issuance of the bonds and 18,034 shares voted against, which gave a majority of 164,456 shares in favor of such issue.

Commonwealth Edison Company Submits Profit-Sharing Plan to Employes.

Directors of the Commonwealth Edison Company, of Chicago, have adopted and submitted to their employes a combination savings and profit-sharing plan from which excellent results are expected. The idea originated with the employes.

A committee consisting of Samuel Insull, president of the company; Edward L. Brewster and Benjamin Carpenter, directors, and L. A. Ferguson, J. H. Goehst, W. L. Abbott and P. Junkersfeld, employes, has been appointed to take charge of the fund and to handle the plan. The committee has elected Mr. Insull chairman, John F. Gilchrist secretary and J. H. Gulick auditor. William A. Fox, treasurer of the company, is ex officio treasurer of the committee.

It is thought that fully a third of the company's 2,500 employes will avail themselves of the opportunity to obtain the stock on the favorable terms offered.

Any employe who has been in the continuous service of the company for one year or more may become a subscriber to the fund. At his own option he may pay into the fund either three or five per cent of his salary as it is received. Unless terminated sooner, each subscriber's period of subscription shall continue for five years.

At the end of that period each subscriber or his estate will receive back all the money contributed by him to the fund, with interest compounded semi-annually at the rate of six per cent a year. If the employe's subscription continues for the full five years he may, at his election, receive instead of a cash payment as much of the company's capital stock as the amount due will pay for at par if the stock is selling above par, or at the average price for two months if the price is below par.

Commonwealth Edison stock is generally above par, and it would be profitable, of course, for the employe to take the stock instead of cash. At present Edison shares are selling at about $121. At that price an employe would make $21 a share on all the stock his accumulated subscriptions and interest would buy at $100 a share.

For employes who terminate their subscription periods within the five-year period or who do not keep up their payments regularly, the terms are not so favorable. An employe who voluntarily discontinues his subscription agreement and remains in the employ of the company will receive four per cent interest instead of six, and employes who fail to make three or more payments promptly in any one year will receive only three per cent.

Leave of absence or temporary lay-off because of a reduction of the company's working forces will not affect a subscriber's rate of interest. Any employe's subscription period will terminate if he leaves the service of the company.

The company has prepared regular savings bank books in which each payment and the interest will be entered as it accrues. The books are patterned after those used by one of the largest savings banks in the city.

An Electric Subway for Mail.

The postal authorities of Vienna, Austria, are considering a scheme for linking together the general postoffice in that city with the sixty-four substations and the nine railroad stations, by means of electric subways, for the transmission of postal matter. This would replace the 450 mail wagons and 700 horses now in use.

The proposed plans call for a subway five feet high and a little less in width. The cars will each carry eighty packages, which is the load of the present type of one-horse mail wagon. The service is intended to be operated from 5:30 a. m. to 10 p. m. each day, and the trains of eight cars will run every twenty minutes. The trains will be automatically operated from the several despatch stations and will travel at a speed of about twenty miles an hour.

It is reported that an electrical firm has undertaken to build and equip the line entirely, and to lease it to the city and postal authorities.

Third Avenue Claims.

Special Master William L. Turner, who was appointed to take evidence in court claims against the Third Avenue Railroad Company, New York city, has filed his report in the United States Circuit Court. He states that Special Master Lay, in the years 1902, 1903, 1904 and 1907, proved claims of $592,956; Special Master Wadhams in the years 1905 and 1906 proved claims of $475,632; Special Master Coxe in the year 1906, $223,970, and Special Master Turner himself, $312,466. In addition claims or accidents happening within four months to date of the appointment of the receivers amounted to $298,502. These claims make a total of $1,903,526.

The American Society of Engineering Contractors.

With the issue last month of Vol. 1 of its *Journal,* containing the constitution and the list of members, the American Society of Engineering Contractors may be fairly said to be launched upon its career.

This latest addition to our engineering societies is the culmination of the efforts of Halbert P. Gillette, consulting engineer, and managing editor of *Engineering-Contracting,* of New York.

In the early part of the year 1906, Mr. Gillette, through the medium of the trade paper of which he is the editor, asked for the co-operation of engineers and others particularly interested in the contracting end of the profession, toward the formation of a society to be devoted to the forwarding of their interests. The need of such a society was evident, and the response was immediate and decidedly encouraging. A large number of gentlemen sent in their names, and after much energetic work on the part of Mr. Gillette a meeting was held in New York on April 14 and 15 last.

The following officers were elected: President, George W. Jackson, president of Geo. W. Jackson, Inc., contractors, of Chicago, Ill.; first vice-president, Halbert P. Gillette, managing editor of *Engineering-Contracting,* of New York; second vice-president, D. E. Baxter, president of the Southwestern Construction Company, of New York; secretary, Daniel J. Hauer, of New York; treasurer, Prof. Alex. Haring, professor of railway and bridge engineering at the University of New York.

The charter list of members comprises about 1,500 names, and it is expected to begin the regular monthly meetings in October next.

The society has been invited to hold a convention in Chicago in February of next year in connection with the Chicago Cement Users' show. The board of directors will very probably act on this invitation at their meeting this month.

To Increase Its Plant.

The General Electric Company, Schenectady, N. Y., will shortly begin the erection of a five-story reinforced structure, 202 by 73 feet in dimension, and to cost over $200,000. The big building will be used exclusively for the storage of patterns and will be fireproof. The contract is to be awarded within a short time.

The company is also doing considerable other construction work.

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

REMOVING HAIR BY ELECTROLYSIS.

The removal of superfluous hairs by means of electrolysis is a very satisfactory minor operation when well carried out. Frequently, however, a small scar is produced at the seat of operation, and in order to avoid such a scar a simple precaution is necessary which is not mentioned in works on medical electricity. It is often spoken of as if the root of the hair were burned by the electricity as a nævus is burned by a cautery point. This is quite a wrong view to take of the operation. The destruction of the root of the hair is caused by an acid or an alkali, generated at the positive and negative poles, respectively. If a needle which is not acted on by acids is used, such as gold or platinum, and it is connected to the negative pole, then nascent chlorine appears round the needle with the formation of hydrochloric acid and destruction of the hair bulb. It is as if a minute quantity of free hydrochloric acid had been injected into the hair follicle. If a needle which is acted on by hydrochloric acid is used, such as zinc, the acid attacks the zinc, forming chloride of zinc, and this goes into solution. If a non-corrodible needle such as gold is used for the operation, and it is connected to the positive pole, free sodium is liberated at the surfaces of the needle; this at once combines with the water of the tissues to form caustic soda, which in turn attacks and destroys the root of the hair. If a corrodible needle, such as a steel needle, is used and is connected to the positive pole free sodium is liberated at the surface of the needle, which at once becomes caustic soda, which attacks the iron, forming oxide, and hydrate of iron. This remains in the hair follicle and therefore does not stain permanently the skin. But there is a much more important action going on in this case which does stain the tissues, and that is the transport of iron ions from the steel needle into the actual cells of the skin, where they are fixed and remain as iron oxide or rust. For this reason a corrodible needle must never be attached to the positive pole in this operation. No pigmentation is therefore produced if one uses a corrodible needle, provided it is connected to the negative pole. When the current is turned on and the needle which is attached to the negative pole touches the skin, acid formation at once begins. As the needle sinks into the hair follicle the acid also penetrates deeper till it reaches and destroys the bulb of the hair. The needle must be left a sufficient length of time to allow sufficient acid to collect in the follicle to destroy the root of the hair. But while the root is being destroyed, so is the skin around that part of the hair which is embedded in the upper layer of the skin, and this destruction of surrounding tissue is the cause of future scarring. This can easily be avoided by a simple method of insulating the needle to within a sixteenth of an inch of its point. When a needle is so insulated and thrust into the root of the hair, the free acid attacks only the root and therefore there is no scarring left after the operation. The method of insulating the needle is very simple. In the first place a fine wire is to be preferred in place of a needle. The wire supplied with the finest hypodermic needle is useful for the purpose. It is finer than a No. 12 sewing needle, which is the finest sewing needle obtainable. Another advantage of this wire is that it has not a sharp point and therefore is not so likely to leave the hair follicle and make a false passage. If too much force is used in introducing the wire it bends and makes further progress impossible. By its extreme fineness it finds its way down by the side of the hair, and in the case of hairs whose roots take a curved course in the skin it follows the curve instead of making a false passage, as the finest sewing needle does. Unless the point of the needle reaches the actual bulb of the hair the operation is useless. Therefore a fine wire with a blunt point is better than a fine sharp needle for the purpose. The wire should be insulated as follows: Hold a piece of shellac in the left hand and the wire in the right. Heat the wire to redness in a Bunsen flame, and while red hot embed it quickly in the shellac all except its point and lift it out again quickly, thus leaving a sixteenth of an inch uncovered by shellac. There is thus a thin layer of shellac left on the wire, and it fits it so well that no irregularity appears to the naked eye in the outline of the wire as compared with its former state. The tip of the wire must not touch the shellac. One-sixteenth of an inch remains naked at the tip of the wire. The wire cuts into the shellac when it is red hot as one cuts a banana with a knife. To sum up, the essentials of good results in this operation are: (1) Connect the needle to the negative pole; (2) use a fine stiff wire as a needle (the wire supplied with the finest hypodermic needle is a suitable one); and (3) insulate the wire so that only the last one-sixteenth of an inch supplies the current. The advantages of this method are two—(1) no scarring after the operation; and (2) a lower per cent of re-growth of hair.—*Extracted from The Lancet (London), June 1*.

ELECTRICAL BLEACHING.

A recent publication of the Siemens establishments calls attention to the advantages offered by electrical bleaching installations in textile, paper and cellulose factories, etc. The electrical bleaching process involves the preparation of a highly concentrated hypochlorite-of-soda solution. The operation is carried out in a special type of Kellner electrolyzer, consisting of a number of receptacles of insulating material divided by vertical glass partitions into two compartments. The elements are arranged alongside of each other and the separating partitions alternate between them in such a way that the electrolyte has to circulate in a serpentine channel. This disposition makes it possible to connect the apparatus directly to an ordinary circuit of 150 volts or less. The horizontally superposed electrodes consist of platinum-iridium grates, the cathodes being placed above and the anodes below. They can be easily removed and replaced. The installation of such an apparatus presents no difficulty. A suitable quantity of brine is prepared in a first vessel and then allowed to settle in a second reservoir of wood or masonry. The clear solution is sent through a cooler forming part of the electrolyzer. From there a small centrifugal pump forces it through the electrolyzer, where the current is passed through it and transforms it into a concentrated hypochlorite-of-soda solution, which may be immediately utilized for bleaching. The cooler contains a coiled pipe, through which

water circulates. A reservoir may be connected with the electrolyzer for storing the concentrated liquid, if it is not to be utilized at once. If the solution is not sufficiently concentrated, it is only necessary to pass it through the electrolyzer again.—*Translated and abstracted from Société Belge d'Electriciens, Bulletin Mensuel (Brussels), June.*

AN INDICATING BELL PUSH.

In order to enable a person operating a bell push to be sure that the bell is in working order, a useful modification of the ordinary push has been designed by the Sun Electrical Company, of London. The device is known as the "Bouverie" indicating push, and gives audible evidence that the bell has been set in motion when the button is pressed. The hardwood base contains a small buzzer connected in series with the line, so that it vibrates synchronously with the bell.

AN INDICATING BELL PUSH.

Apart from its value as an indicator that the bell circuit is in proper working order, the device gives warning of the approaching exhaustion of the battery by its feebler operation. Although intended primarily for simple bell circuits, the "Bouverie" principle could be adapted for use with any push-button-operated system, or with battery call telephones, either of the domestic "Metaphone" pattern, or the more complex types employed for intercommunication purposes.—*Extracted from The Electrical Times (London), June 17.*

A NEW INSTRUMENT FOR X-RAY WORK.

In the field of Roentgen-ray work measuring instruments are wanting almost entirely. Milammeters with movable coils have usually been employed for measuring the current flowing through a Roentgen tube, but their indications are not correct, for the reason that the current is not direct, but more or less unsymmetrically alternating. An induction coil, the primary of which is excited by interrupted direct current, gives a tension in the secondary which may be represented by a curve with positive and negative maxima of different values, the smaller negative half-wave being caused by the retarded closing of the circuit. The amount of current forced through a Roentgen tube is therefore dependent, not only on the maximum values of the positive tension, but negative waves will also pass through it, if its resistance is not too high. A movable-coil milammeter will give correct indications only when the tube is so hard that none but the high-tension, positive-current impulses can pass; but this condition is very rare, and usually a current flowing in both directions, with smaller negative waves, has to be reckoned with. A current of this kind affects the movable coil of the instrument in two directions, and each positive impulse is decreased by the smaller negative impulse, so that the instrument indicates a current equal to the average difference between the two half-waves. Thus it may happen that, under the proper conditions, the needle of the milammeter will point to zero or even give a negative indication. Electromagnetic measuring instruments with a movable soft-iron core in the interior of a coil are independent of the direction of the current, so that the effect of a positive wave is not diminished, but maintained by a succeeding negative wave. An instrument of this kind, connected in series with a Roentgen tube, will indicate the full current intensity. However, it will not show how much current is effective in the production of the rays and how much is lost in the negative waves; but from the indications of both instruments, these relations may be easily ascertained. By connecting one of each type of meter in series with a Roentgen tube, all the variations in the circuit and changes in the condition of the tube may be observed, and the tubes may also be compared as to hardness. The Hartmann & Braun Company, of Frankfort, has combined the two instruments into one measuring arrangement for use in Roentgen - ray laboratories.—*Translated and abstracted from Elektrotechnische Zeitschrift (Berlin), June 3.*

ELECTRICITY IN COAL MINES.

In the course of a recent lecture at the Heriot-Watt College, Edinburgh, Scotland, before an assemblage of mining men, Prof. F. G. Baily gave an account of the dangers of the use of electricity in coal mines, and suggested reforms to minimize them. The lecturer pointed out that in a fiery mine a flame or spark of any kind was fatal, and, unfortunately, in the manipulation of electricity sparks were practically unavoidable. The blowing of a fuse produced a most vigorous flash. The breaking of the electric current by a switch produced a spark, large or small. The starting switches of motors produced sparks, and at the commutator of a direct-current motor there were invariably sparks. The explosion due to gas in a motor was demonstrated. The advantage of the three-phase motor, especially the kinds without slip rings, was pointed out. Managers and inspectors responsible for the safety of mines should be well trained and adequately recompensed, and facilities should be afforded for the testing of electrical mining plant under realistic conditions, so that they could know whether their endeavors to increase the safety of the appliances were along the right lines. —*Extracted from The Engineer and Iron Trades Advertiser (Glasgow), June 22.*

CARBORUNDUM IN RADIOTELEGRAPHY.

Carborundum is now being extensively used as a detector in wireless telegraphy, and is supplanting silicon, molybdenite, and other substances for this purpose because of its greater reliability, inasmuch as it is affected to a hardly noticeable degree by the heavy discharges of the sending apparatus and so does not require a new adjustment after each period of sending. Carborundum comes from the electric furnaces at Niagara Falls in cakes about an inch or two in thickness, and in color ranges from a silver-gray to plain black, sometimes with all the colors of the spectrum interspersed. This color scheme does not mix in one jumble, but runs in sections, and the dark blue, solid portion of a cake is the part the wireless man is after. Carborundum seems to be the hardest when the color is dark blue, and when a piece of this kind is used the oscillations give a sharp, clear tone in the receiving telephones, which quality seems to be lacking in the other colors; for when it is of any other color it seems to be softer and the sounds are inclined to be mushy. The writer (J. O. Smith) has made a careful study of this question and can procure no carborundum of any color that can approach in any way the dark blue for sensitiveness and general utility. Carborundum has a positive and negative side and careful adjustment must be made with this in view in wireless work. It also has a high resistance to direct current, but is susceptible to alternating-current oscillations, one reason why it is so useful in wireless telegraphy. — *Extracted from Power and The Engineer, June 29.*

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

A NEW OVERLOAD INVERSE-TIME-LIMIT RELAY.

BY HAROLD W. BROWN.

From the standpoint of uninterrupted service, the ideal protection against overload on a heavily loaded power or lighting circuit is one that opens the circuit only after the overload has continued long enough to approach more or less nearly to the danger point. The greater the importance of uninterrupted service, the nearer is it wise to approach the danger point. For such automatic control the protecting apparatus must have a time limit that depends on the amount of overload—being almost instantaneous in case of a short-circuit, but allowing a considerable time element in case of a small overload. It should also be capable of variation so that the time element and the rated full load may be increased or decreased as conditions require.

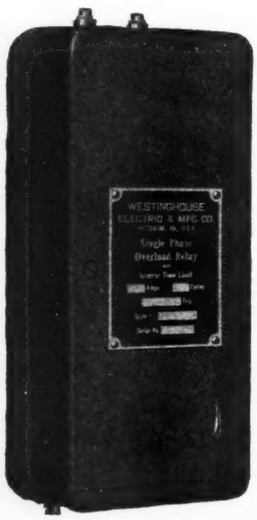


FIG. 1.—VIEW OF COMPLETE RELAY.

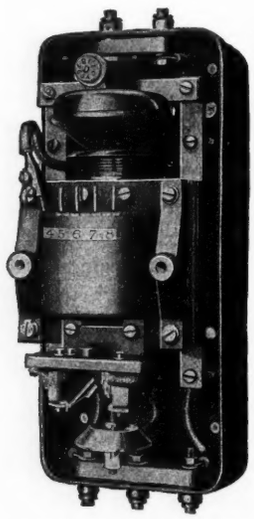


FIG. 2.—VIEW OF RELAY WITH COVER REMOVED.

A new relay having several unique features, and offering exactly the protection just referred to has been designed by the Westinghouse Electric and Manufacturing Company and is known as its type B. It is successful in overcoming the greatest difficulties hitherto experienced in the operation of overload inverse-time-limit relays.

This relay is shown in Fig. 1. The same instrument with the cover removed is shown in Fig. 2. It is simple in its construction. The stationary part consists of a current coil mounted in a laminated-iron shell, and a needle valve in the metal framework of the bellows. The moving part consists of a brass rod on which are mounted an iron core inside the coil, a contact cone below, and the bellows above the coil. The relay is enclosed in a dustproof case. The winding of the coil is represented diagrammatically in Fig. 3. One end of the winding connects to one of the binding-posts, and leads are brought out from several points. The terminal T is on a flexible cable and may be connected to any one of the leads from the coil. Thus a part or all of the winding may be connected in circuit between the two binding-posts of the relay. There are five current settings, viz., for four, five, six, seven and eight amperes. The number of turns decreases in proportion as the current rating increases, so that the ampere-turns are the same for any current setting. The size of wire is larger for the larger current capacities, so that the loss in watts at full load due to resistance is approximately the same for any capacity, being seven watts in case of the four-ampere setting, and eleven watts with the eight-ampere setting. This watt loss is exceptionally low for an instrument of this kind.

The laminated-iron shell around the coil has an ample sectional area, and forms a good magnetic circuit with the core. The shell supports the coil firmly, and is mounted on the base of the relay. The core is very light, but so constructed magnetically that it exerts an ample force for drawing up the moving parts and making the contact.

The bellows leather consists of two thicknesses of a fine quality of lightweight leather, specially treated to render it impervious to air, flexible and durable. The escape valve of the bellows is a needle valve. Each needle is specially ground to allow the right escapement of air. A numbered dial is mounted on the needle to indicate the setting of the valve. This dial renders it possible to set the valve with great accuracy.

This instrument is adjusted at the time of calibration so that the iron core just strikes the iron shell when the moving element is in its highest position. Such an adjustment prevents violent vibration of the moving element. This violent vibration has introduced a serious difficulty of the operation of other relays of this kind on heavy overloads at low frequency, because it prevented their operating properly in the normal time. It was overcome in the original design of this relay, because one of the first conditions imposed was prompt and normal operation on low frequency with very heavy overload. It would be impossible to use this method of damping out the violent vibrations, if the various current settings were obtained by moving the iron core, but inasmuch as the core is in the same position for all set-

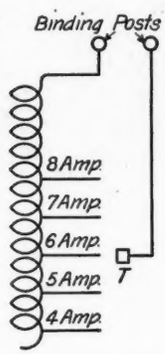


FIG. 3.—DIAGRAM OF RELAY CONNECTIONS.

tings of the relay its behavior is very satisfactory.

The weight of the moving element is counterbalanced by a spring, so that only a slight magnetic pull is required to make it operate. For this reason, and on account of the small weight of the core and the good magnetic circuit, it is possible to have the resistance and inductance of the relay very low. This has two distinct advantages. First as to heating: The relay runs cool under all conditions. If the load is heavy enough to heat the relay more than forty degrees centigrade, it is enough to make it operate and open the circuit, so that it is practically impossible for the relay to heat more than this, but the winding has a special insulation capable of withstanding several times this amount of heating. The second advantage is that of low voltage drop: These relays are ordinarily used with series transformers and unless the voltage drop is low the accuracy of the transformer ratio is affected. This matter is of considerable importance where measuring instruments are connected to the same series transformers.

This relay is capable of a very wide range of adjustments as illustrated by the curves in Fig. 4. The number on each curve corresponds to a number on the needle-valve dial. All the curves except No. 1 are the same for all relays. There is a small variation of No. 1 on different relays. One of the great advantages that this relay possesses is the fact that variations may be made in the time setting without affecting the normal full-load rating, and variations may be made in the normal full-load setting without affecting the time of operation at a given percentage in excess of full load. The curves are drawn showing the operation on a basis of percentage overload, assuming that the overload begins as soon as the current exceeds the normal rating, which may be anything from four to eight amperes. From this it will be seen that the relay has an extremely wide range of adjustment. For example, without changing the current setting the time required for operation at fifty per cent overload may be varied from one to eleven seconds. This range may be still further increased by varying the current settings. It will be noted that the scale divisions indicating the horizontal distances in Fig. 4 are not uniform, but are made on a logarithmic scale. This method of representation is employed because the curve is more compact when drawn in this way. It is thus possible to show clearly the operation of the relay on any load up to five times full load.

In some cases two relays are affected by the same overload. For example, one may be on a main feeder and one on a branch; or one may be at the generator end and the other at the load end of the same feeder. In either of these cases it is essential that if possible only the relay nearer the load end shall operate when the overload occurs. The other relay serves as a protection in case of ground on the line between the generator and the second relay. This selective action may be secured either by adjusting the relay nearer the generator for a longer time element, or by setting it for a larger current. By referring to the time-load curves, this setting may be accomplished with ease because there are wide spaces between the curves, and because the relation between time element and percentage overload is absolutely independent of the current setting on which the rated full load is based.

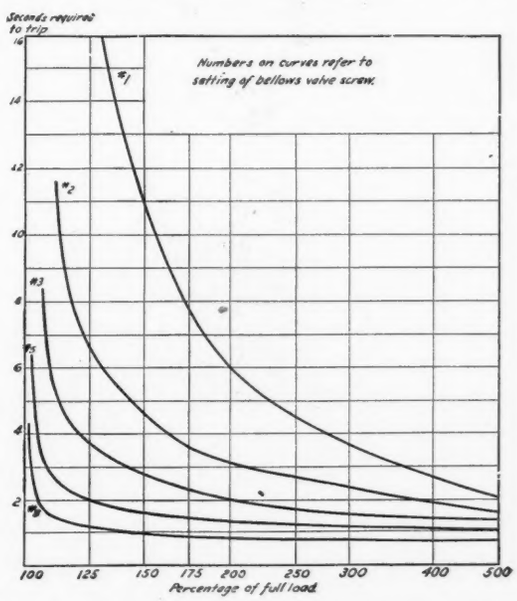


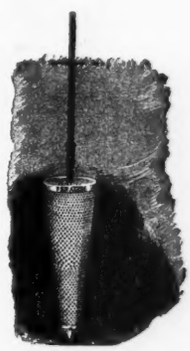
FIG. 4.—OVERLOAD CURVES FOR RELAY OPERATION.

Another point of excellence of this relay is its "resetting," or returning to its position of rest. The relay must reset promptly whether the overload continues long enough to trip the circuit-breaker, or whether it is too short to exceed the time limit. This resetting condition is necessary because if the relay does not reset it does not introduce a sufficient time element when the next overload occurs. On the other hand, if the relay resets too quickly it may interfere with the normal operations. This relay resets in the same time as it takes to operate at twenty to fifty per cent overload, and it begins to reset as soon as the load drops to sixty per cent of the load that would make the relay operate. This time for resetting is so short that if the circuit-breaker is opened the relay resets before the circuit-breaker is closed, but it is not so short as to interfere with the normal operation of the relay.

The Paragon Ground Cone.

The Paragon ground cone is a pure copper cone, perforated to allow the entrance of moisture. The cone is filled with charcoal, which attracts and holds moisture, thus keeping the earth around the cone damp all the time, and insuring a perfect ground.

It is a well-known fact that telephone distributing frames and protector frames should be grounded, and it is also a general practice to ground pole cable terminals and large toll-line arresters. Many companies also ground the messenger and the cable sheath, and for all of these purposes the Paragon ground cone is well adapted.



PARAGON GROUND CONE.

The Paragon ground cone is very easy to install, as it is necessary only to bore a post hole and drop the cone in. Moreover, the cone can usually be buried to a much greater depth than makeshift grounds and at practically no extra expense.

The cone is made in one-foot and two-foot lengths. The one-foot cone furnishes ample surface for grounding distributing frames or switchboards up to 100-pair capacity. The one-foot cone is also recommended for pole-cable terminals of any size for grounding the sheath or messenger and for toll-line arresters. The two-foot cone is adapted for use on frames or switchboards up to 1,000 lines, and for larger frames the cones are generally

used in batteries; that is, several leads are run off from the ground wire and each attached to a cone or else several ground wires are run, each one ending in a Paragon ground cone.

A hollow, braided copper cable runs entirely through the cone, as shown in the illustration. This cable is made hollow, so that the ground wire can be inserted and pushed right down to the bottom of the cone; then, by simply pulling the cable, it closes tight around the ground wire, in somewhat the same manner as a cable come-along closes and pulls on the cable. The ground wire should then be soldered to the cable around the top of the cable, and a perfect connection will then be absolutely assured. Many

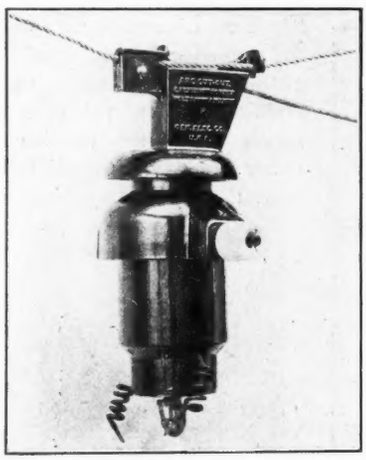


FIG. 1.—AUTOMATIC HANGER AND CUT-OUT FOR SPAN SUSPENSION IN SERVICE.

telephone companies also put coke around the outside of the cone when burying it, but in most soils this is not necessary.

The Paragon ground cone has already been adopted by a large number of telephone companies and electric-light, power and traction companies. Frank W. Pardee, of 48 Fifth Avenue, Chicago, is the manufacturer.

New Cut-Outs for Arc-Lighting Service.

A new design has been perfected in cut-outs for both series and multiple arc-lighting circuits, which will add greatly to the convenience and safety of lamp trimmers. The old style of cut-out made use of a switch for breaking the circuit, whereas the improved form is automatic in action, the lamp being disconnected from the line by simply pulling the supporting rope.

Fig. 1 shows the series cut-out as connected in service. The circuit is closed by means of spring contacts, and a unique locking device holds the lamp in position. This device is very ingeniously contrived to release the lamp when it is lifted slightly from its normal position. It can then be lowered to the ground, as shown in Fig. 2, and necessary repairs can be made without the slightest danger to the lineman.

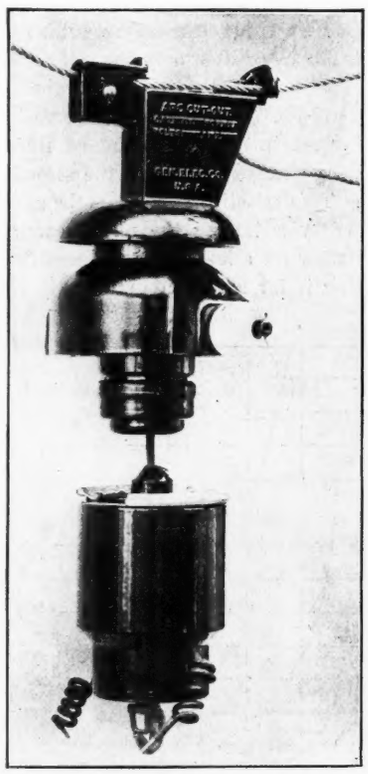


FIG. 2.—AUTOMATIC HANGER AND CUT-OUT FOR SPAN SUSPENSION, LOWERED FOR REPAIRS.

A cut-out of similar design is available for use on multiple arc-lighting circuits. Both the cut-outs are manufactured by the General Electric Company.

Recent Installations of Electric Mining Machinery.

Among some of the recent notable installations of electrical mining machinery in several of the western states there may be noted the following:

A new blower house at the Washoe smelter of the Anaconda Copper Mining Company, at Anaconda, Mont. It contains four 600-horsepower motors driving Root blowers, and two additional 600-horsepower, slow-speed motors driving high-pressure air compressors for pneumatic locomotive service.

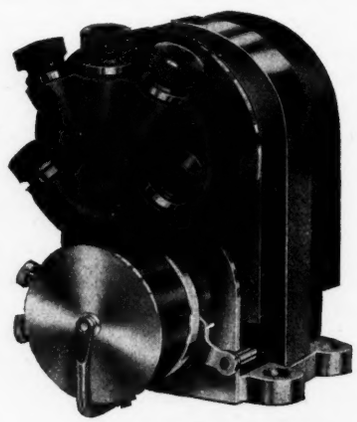
The Helena Power Transmission Company has equipped a turbine plant at Butte, Mont. This supplies the local Butte mines in parallel with a 70,000-volt, eighty-five-mile transmission line. This turbine plant has made some remarkable records in overload and emergency service.

The installations mentioned above have been furnished by the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa.

A Simple Low-Tension Magneto.

The low-tension magneto illustrated herewith is probably one of the simplest and most efficient machines on the market. This is the Model E "Radium" magneto for four-cylinder four-cycle internal-combustion engines and is manufactured by the General Accumulator and Battery Company, of Milwaukee, Wis.

The system used is that having an armature of but one winding, and during each revolution two impulses of current are produced and distributed to the various cylinders by means of a distributor on the



MODEL E "RADIUM" MAGNETO.

magneto. The insulation presents no difficulties on account of the low-tension current produced. The current is discharged through a transformer having low and high-tension windings similar to a regular spark coil. This steps the current up to a voltage sufficiently high to enable it to jump the gap of the spark plug.

The mechanical details have been perfected to the simplest possible form consistent with reliability. No tools beyond an ordinary screwdriver are necessary for taking down, assembling, or adjusting. H. & B. ball bearings are used throughout, no oiling is necessary, and the whole device is thoroughly dustproof.

The magneto is designed for continuous service, and is sold under guarantee.

The over-all dimensions are as follows: Height six-and-seven-eighths inches, width five-and-one-half inches, length eight inches. The distance between the lugs from center to center is four-and-one-half inches, and the distance between centers on the holes for the cap screws, two inches.

Electric Drive in Patternmaking.

One of the best installations of electrical apparatus in a pattern shop in Western Pennsylvania is located at West Homestead, in the works of the Mesta Machine Company. The two floors of a reinforced concrete building are devoted exclusively to the pattern shop, giving it an exceptionally favorable location in every respect. The natural light is excellent, the machines are all driven by individual motors, so that there are no overhead belts, and the wiring is entirely concealed, making the general appearance of the shop particularly clean and attractive.

The shop is equipped throughout with new machinery suitable for the preparation of the patterns required for the large engines and rolling-mill machinery manufactured by this company, and everything is modern and up-to-date in the equipment.

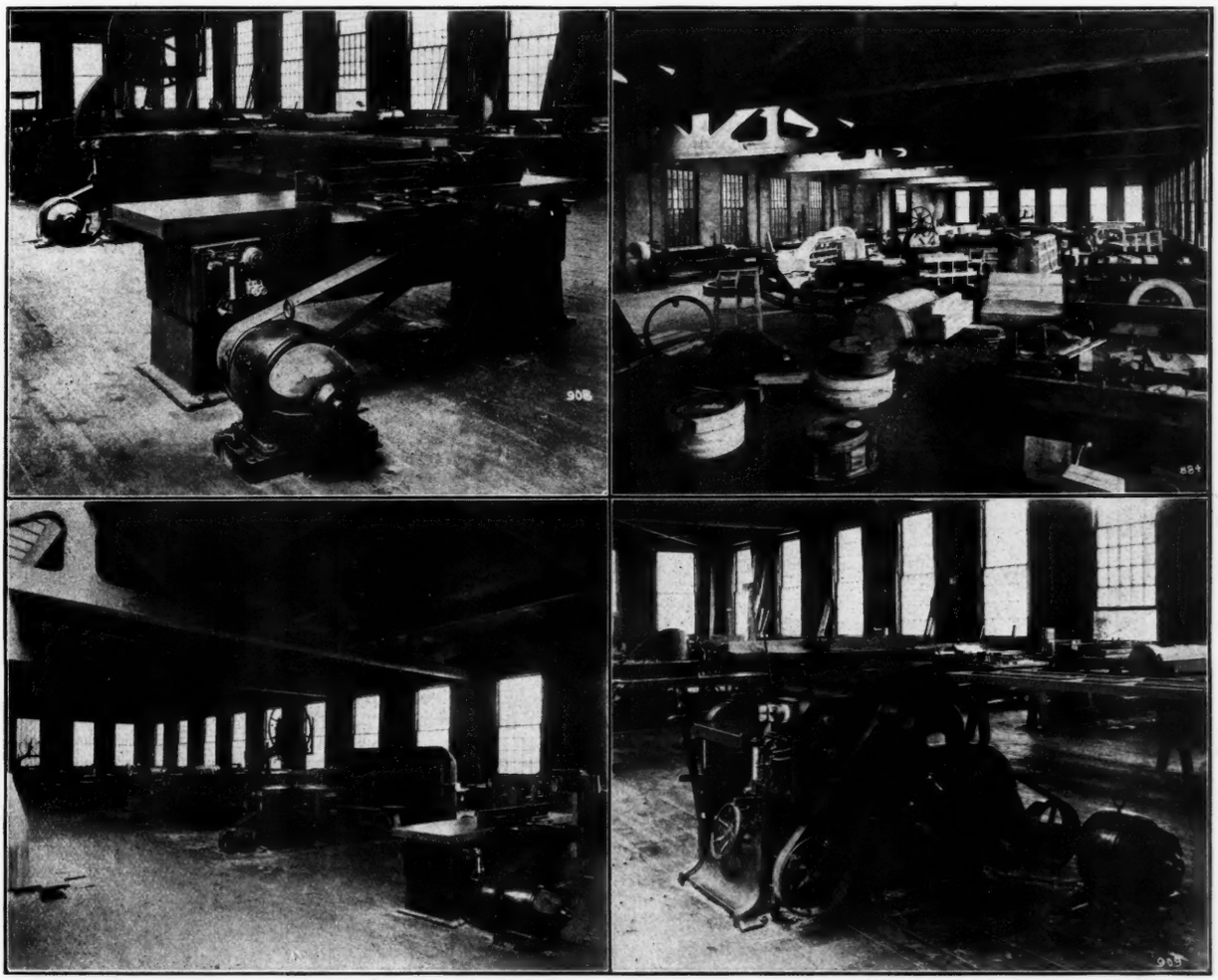
An idea of the general layout of the shop is given in the illustrations. One of these shows the shop floor cleared of work, while another photograph was taken with patterns of various descriptions in different states of completion.

The equipment includes three bench saws, three band saws, a swing saw, three surfacers, three jointers, three lathes, a pony planer and a pattern scroll saw. Each machine is driven by its own motor, either belted or, in a few cases, as with the two speed lathes, direct-connected. The planer and the surfacers are driven by a countershaft to which the motor is direct-connected. The motor for the scroll-pattern saw is directly coupled to the crank-wheel, providing a most compact equipment.

The motors are largely three-and-one-half or five horsepower. This is due to the fact that it was desired to secure as many motors as possible of one size, in order to keep the repair parts carried in stock a minimum. These five-horsepower motors, running at 1,600 revolutions per minute, and the three-and-one-half horsepower motors, running at 1,050 revolutions per minute, are built on the same frame, and all parts, except armatures and field windings, are interchangeable. Spare armatures and field coils of each type are kept in stock in readiness for any accident.

The motors are of the direct-current, 220-volt, shunt-wound type. To prevent damage to the commutator by the accumulation of dust and dirt, the electrical superintendent, F. G. Galbraith, has devised a neat wire covering, which affords ample ventilation and yet prevents the shavings, etc., from getting inside the motor. Protection to the belts from dirt, etc., and to the operator in case of a broken belt, is afforded by a special steel guard, which is fastened to the floor and to the motor frame, and completely encloses the belt. This device, made by the Mesta Machine Company, for this purpose, is shown in the illustrations.

The wiring is all carried in an eight-inch conduit, in the floor, which runs the



MOTOR-DRIVEN JOINTER.
GENERAL VIEW OF PATTERN SHOP.

INTERIOR OF PATTERN SHOP, SECOND FLOOR.
MOTOR-DRIVEN PONY PLANER.

full length of the shop, with outlets at each machine. This conduit is packed with kiln-dried silica sand, which absolutely prevents any possibility of arcing or fires. The switchboard is in a separate room, where the saw filing and knife grinding are done by an automatic filing machine, which is arranged so that the band saws may be loosely looped over an old band-saw wheel.

In addition to the motor there are nine glue pots, electrically heated, where all the glue is warmed. Practically the entire motor equipment, together with the glue pots, was supplied by the Westinghouse Electric and Manufacturing company. The motors are known as type R, for direct-current service.

An Improved Metal-Clip Wood Cut-Out Box.

With storm or cut-out boxes exposed to the inclemencies of the weather it is desirable to have a catch which can readily be released or secured by one hand so that the other hand may be free for other purposes. The common form of rotary knob and latch used in house doors is too complicated and withal too expensive for this purpose.

FIG. 1.—ASHLAND CUT-OUT BOX.

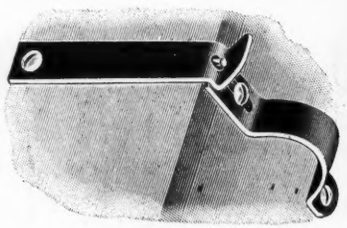


FIG. 2.—ASHLAND PATENT BOX STRAP AND LATCH.

The new form of catch shown in the accompanying illustrations, has been invented by Thomas Q. Andrazyk, of Chicago, which completely fills all the above requirements. The catch is made of steel and is practically indestructible. Only three screws and one pilot pin are necessary to attach it to the box, and it can be readily opened by the thumb and forefinger of one hand.

Fig. 1 shows the cut-out box with this new form of catch, and Fig. 2 is an enlarged view of the catch itself.

The box is made of wood and is provided with a hinged cover. It is designed for use as a storm box, or for holding electric apparatus as cut-outs, switches and the like. It is painted inside with asphaltum paint, or lined with asbestos, depending on the particular use for which it is intended. The box is so constructed that the cover will shut down between the ends and sides of the box, and the cover is further devised so as not to be affected by warping.

This improved form of cut-out box is manufactured by the Ashland Electric Company, of Chicago, Ill.

Car Lighting with Opalux Reflectors.

Within the past year the subject of electrically lighted trains has received much attention by the railroad managements, and an indication of how important the development is considered by those interested in car lighting is the organization and growing membership of the Association of Car-Lighting Engineers.

The introduction of tungsten lamps has given a decided impetus to car lighting, and with this has come a demand for new types of reflectors. One of the most serious practical drawbacks to efficient car lighting with reflectors is the inevitable collection of dust or dirt, and, as is well known, the efficiency of the average type of reflectors is seriously impaired by this unavoidable accumulation. With the ordinary type of reflector it is absolutely essential that the lamps be removed, and the reflectors subjected to a thorough washing in order to remove the dust or dirt. This necessitates constant attention, and is frequently costly, in that, aside from the actual expense of time and wages of the caretakers, an additional and very heavy expense is introduced due to the breakage of reflectors and tungsten lamps incident to the necessary handling, and which is quite unavoidable.

DINING-CAR LIGHTING WITH OPALUX REFLECTORS.

Realizing the disadvantages under which the car lighting is being conducted, the Central Electric Company, of Chicago, has been experimenting with its well-known "Opalux" reflector, and the results so far have proven very gratifying. The accompanying illustration shows a dining car completely equipped with Opalux bowl-type reflectors, and from the experience so far gathered it would seem that this new type of reflector will prove a very efficient aid in the proper illumination of railway cars. Opalux reflectors are artistic in appearance, and the reflected light is slightly opalescent. The transmitted light shows a variation of soft colored tints, and illuminates the ceiling with a warm glow, entirely free from sharp contrasts in intensity. The ornamental detail has been designed to present no sharp corners or deep grooves, but affords an even surface very readily cleaned.

The results secured by these reflectors in connection with car lighting will be closely watched, as it is a subject which is receiving the most careful attention from car-lighting engineers.

Electric Vehicle Reorganization.

The Columbia Motor Car Company of Hartford, Conn., which is to take over the property of the old Electric Vehicle Company for the manufacture of automobiles, has filed with the Secretary of State a certificate of amendment, before organization, to the certificate of incorporation whereby the new company's capital stock will be increased from $48,000 to $3,000,000. The stock is divided into 30,000 shares of the par value of $100 each, divided into 20,000 shares, or $2,000,000 preferred stock and 10,000 shares or $1,000,000 common stock.

The holders of the preferred stock shall be entitled to non-cumulative dividends at the rate of six per cent per annum before any dividends shall be paid on common stock.

After the payment of the six per cent on the preferred stock during the year, five per cent may be paid on the common stock. The amount of the authorized capital stock with which the company will start business is $2,389,200. The incorporators are Lucius F. Robinson, Albion B. Wilson and Francis M. Cole.

Committees of the Underwriters' National Electric Association.

The following list of committees of the Underwriters' National Electric Association has been submitted by C. M. Goddard, secretary, 141 Milk Street, Boston, Mass.:

Committee on Signs and Outline Wiring.—Dana Pierce, chairman, 382 Ohio Street, Chicago, Ill.; J. C. Forsyth, 34 Nassau Street, New York city; W. Devereux, 135 South Fourth Street, Philadelphia, Pa.; A. A. Pope, 55 Duane Street, New York city; L. G. Shepard, Federal Electric Company, Chicago, Ill.; W. N. Knapp, Jr., A. & W. Sign Company, Cleveland, O.

Committee on Rule 64, Signaling System.—F. E. Cabot, chairman, 55 Kilby Street, Boston; Ralph Sweetland, 141 Milk Street, Boston; E. A. Fitzgerald, Box 298, Syracuse, N. Y.; C. H. Hill, 316 Walnut Street, Philadelphia, Pa.; Minor M. Davis, 253 Broadway, New York city; C. C. Johnson, 195 Broadway, New York city; H. S. Warren, 15 Dey Street, New York city.

Committee on Rule 2-A.—G. E. Bruen, chairman, 135 William Street, New York city; Arthur Williams, 55 Duane Street, New York city; W. H. Blood, 147 Milk Street, Boston.

Committee on Switches and Cutouts.—H. O. Lacount, chairman, 31 Milk Street, Boston; J. E. Cole, 11 Wareham Street, Boston; Dana Pierce, 382 Ohio Street, Chicago, Ill.; Ralph Sweetland, 141 Milk Street, Boston; F. E. Cabot, 55 Kilby Street, Boston.

Committee on Variable-Speed Motors.—H. O. Lacount, chairman, 31 Milk Street, Boston; C. E. Skinner, Westinghouse Electric & Manufacturing Company, Pittsburg, Pa.; H. R. Sargent, General Electric Company, Schenectady, N. Y.

Committee on Approval of Laboratory Reports.—George E. Bruen, chairman, 135 William Street, New York city; Dana Pierce, 382 Ohio Street, Chicago, Ill.; J. C. Forsyth, 34 Nassau Street, New York city.

Committee on Fixtures and Fixture Wire.—Dana Pierce, chairman, 382 Ohio Street, Chicago, Ill.; E. A. Fitzgerald, Box 298, Syracuse, N. Y.; W. S. Boyd, 125 Monroe Street, Chicago, Ill.

Committee on Auto Starters.—C. H. Hill, chairman, 316 Walnut Street, Philadelphia, Pa.; Dana Pierce, 382 Ohio Street, Chicago, Ill.; F. E. Cabot, 55 Kilby Street, Boston.

Committee on Recodification of Code.—C. M. Goddard, chairman, 141 Milk Street, Boston; H. O. Lacount, 31 Milk Street, Boston; J. E. Cole, 11 Wareham Street, Boston; W. H. Blood, Jr., 147 Milk Street, Boston; E. McCleary, 423 Stevens Building, Detroit, Mich.

Committee on Cut-Out Cabinets.—A. R. Small, chairman, 382 Ohio Street, Chicago, Ill.; W. S. Boyd, 125 Monroe Street, Chicago, Ill.; R. A. Smith, city electrician, Norfolk, Va.; A. F. Hills, Crouse-Hinds Company, Syracuse, N. Y.; J. R. Strong, 35 South William Street, New York city; F. B. Adams, Frank Adam Electric Company, St. Louis, Mo.; H. B. Bloomer, 507 Mitchell Building, Milwaukee, Wis.

Committee on Rule 13-A.—C. M. Goddard, chairman, 141 Milk Street, Boston; F. E. Cabot, 55 Kilby Street, Boston; E. V. French, 31 Milk Street, Boston.

Committee on Rheostats.—George E. Bruen, chairman, 135 William Street, New York city; J. C. Forsyth, 34 Nassau Street, New York city; A. R. Small, 382 Ohio Street, Chicago, Ill.

Committee on Induction Motors as to Wires and Fusing.—G. S. Lawler, chairman, 31 Milk Street, Boston; F. E. Cabot, 55 Kilby Street, Boston; H. S. Wynkoop, 13 Park Row, Manhattan, New York city; C. E. Skinner, Westinghouse Electric & Manufacturing Company, Pittsburg, Pa.; H. R. Sargent, General Electric Company, Schenectady, N. Y.

Committee on Circuit-Breakers.—A. M. Schoen, chairman, 339 Equitable Building, Atlanta, Ga.; Dana Pierce, 382 Ohio Street, Chicago, Ill.; H. Ward Leonard, Bronxville, New York city; A. W. Berresford, Cutler-Hammer Manufacturing Company, Milwaukee, Wis.; T. S. Perkins, Westinghouse Electric & Manufacturing Company, Pittsburg, Pa.; H. R. Sargent, General Electric Company, Schenectady, N. Y.; W. M. Scott, Cutter Electric & Manufacturing Company, Philadelphia, Pa.

Committee on Theatre Wiring—J. E. Cole, chairman, 11 Wareham Street, Boston; H. S. Wynkoop, 12 Park Row, Manhattan, New York city; Washington Devereux, 131 South Fourth Street, Philadelphia, Pa.

Committee on Block Distribution, Rule 12 and Rule 15-D.—Washington Devereux, chairman, 131 South Fourth Street, Philadelphia, Pa.; H. G. Veit, 610 Park Building, Cleveland, O.; J. E. Cole, 11 Wareham Street, Boston; H. S. Wynkoop, 13 Park Row, Manhattan, New York city; Robert Lindsay, Electric Illuminating Company, Cleveland, O.

Committee on Theft of Current.—J. C. Forsyth, chairman, 34 Nassau Street, New York city; Arthur Williams, 55 Duane Street, New York city; G. E. Palmer, Price McKinlock Company, 156 Pearl Street, Boston.

Committee on Wireless Telegraphy.—F. E. Cabot, chairman, 55 Kilby Street, Boston; A. R. Small, 382 Ohio Street, Chicago, Ill.; C. E. Russell, 18 Western Avenue, Cambridge, Mass.

Committee on Rules 41-45.—Dana Pierce, chairman, 382 Ohio Street, Chicago, Ill.; F. H. Wentworth, 87 Milk Street, Boston; G. E. Bruen, 135 William Street, New York city; A. H. Nuckolls, 382 Ohio Street, Chicago, Ill.; Wallace S. Clark, General Electric Company, Schenectady, N. Y.; G. T. Manson, Okonite Company, New York city.

Committee on Rule 1-D.—W. S. Boyd, chairman, 125 Monroe Street, Chicago, Ill.; Dana Pierce, 382 Ohio Street, Chicago, Ill.; R. S. Twitchell, Western Electric Company, 115 Purchase Street, Boston.

Committee on Junction Boxes.—F. E. Cabot, chairman, 55 Kilby Street, Boston; Dana Pierce, 382 Ohio Street, Chicago, Ill.; J. C. Forsyth, 34 Nassau Street, New York city.

Committee on Street Railway Property.—Ralph Sweetland, chairman, 141 Milk Street, Boston; William McDevitt, 131 South Fourth Street, Philadelphia, Pa.; B. E. Loomis, 19 Liberty Street, New York city; O. B. Johnson, 55 Kilby Street, Boston; H. F. Strickland, 27 East Wellington Street, Toronto, Can.

Convention of the American Street and Interurban Railway Association.

The American Street and Interurban Railway Association, in a bulletin issued July 1 to the members of the American Street and Interurban Railway Association, Railway Accountants' Association, Railway Engineering Association, Claim Agents' Association, Railway Transportation and Traffic Association and the Railway Manufacturers' Association, makes some important announcements concerning the approaching convention in Denver.

The Brown Palace has been decided upon as the headquarters hotel of the American Association, and similarly of the Manufacturers' Association. The Savoy Hotel will be the headquarters of the Accountants' Association, and the Adams will be the headquarters hotel of the Engineers. The Claim Agents' Association will utilize the Metropole as headquarters and the Transportation and Traffic Association will establish its headquarters at the Albany Hotel.

The matter of transportation is being vigorously pushed, but at this date it is not possible to give definite information on this point. The association has been able to secure positively for its delegates an extension of the summer-tourist rates from Chicago to Denver, but the matter of a similar extension from the eastern territory has not yet been decided, and positive announcement on this point cannot, therefore, be made. It is the intention of the association, however, to issue a bulletin devoted to the matter of transportation, and it is hoped to distribute this information as soon as possible. This proposed bulletin will contain as much detailed information as possible on railroad fares and equivalent Pullman rates, from various cities of the country, also information concerning transportation committees, giving the names of the committeemen and the territory assigned.

The date of the convention is October 4 to 8, 1909.

Rockingham Power Company Sale.

Advices from Raleigh, N. C., announce the sale of the Rockingham Power Company's property on Monday, July 12. The case is entitled "In the United States Circuit Court of the Eastern District of North Carolina: S. Morgan Smith Company, complainant, against the Rockingham Power Company and the Knickerbocker Trust Company, defendants.

"Knickerbocker Trust Company, cross-complainant, against Rockingham Power Company, William H. Browne, and W. A. Leland, as receivers of the property of the Rockingham Power Company, and S. Morgan Smith Company, respondents."

The sale will take place in Wadesboro, N. C., when there will be offered all of the property of the company included in a deed of trust to the Knickerbocker Trust Company, given July 1, 1906, and made a part of the cross-bill in the above entitled suit, with all property acquired by the company since the filing of the mortgage. The property embraces extensive water rights, waterpowers, etc., along the Pee Dee River in North Carolina, together with properties, etc., conveyed by Hugh MacRae & Company, of Wilmington, to the Rockingham Contracting Company, also all dams, power houses, material, structures, telephone lines, etc., and electrical machinery, and appliances, plans, and the like, of the Rockingham Power Company; also about 250 rights-of-way, etc., the purchaser to put up $25,000 cash, or to furnish $100,000 bonds issued to the Knickerbocker Trust Company, the remainder of the purchase price to be paid in bonds issued under the aforesaid mortgage, bonds to be reecived at sum equivalent to the sum which would be payable out of the net proceeds of such sale to the holder of said bonds for a just share of that character of such net proceeds upon a due accounting and apportionment, etc., of such proceeds. The court reserves the usual rights and privileges in such cases, these being enumerated in the notice of sale of the property.

This property and plant has for many months been the subject of much tangled litigation. The property is exceedingly well located and a large sum has already been expended in this centrally located electrical development. L.

Radium on Free List.

One of the changes made in the tariff bill is the adoption of a new amendment putting radium on the free list in the interest of medical science.

Current Electrical News

CONTINENTAL EUROPE.

(Special Correspondence.)

PARIS, JUNE 28.—The following new companies have been formed at Paris: The Heinz Accumulator Company; Wurtz and Buisson, electric-light fixtures; Burel, Pont et Cie., electric plants; Chobillon and Guyot, electric apparatus; Carpentier, Rivière et Cie., electric supplies. In France there have been formed the Champagne Electric Company, at Arc-Senans; Sir and Morel, at Vincennes, electric light and power; G. Devise et Cie., at Escouté, electric lighting; Eug. Wibratte, at Lille, for electric-light plants; Paradis et Cie., electric apparatus, at St. Etienne. At Brussels, I note the formation of the Belgian Siemens and Halske firm, having its headquarters at Brussels, and the Auxiliary Electric Enterprise Company, in the same city.

Some interesting experiments in wireless telephony were carried on not long since by Captain Colin and Lieutenant Jeance, of the French Marine. One station was located on the shore of the Mediterranean near Toulon, and the other upon the vessel "Condé" of the fleet. They were able to make communication when the vessel was 110 miles out at sea during these experiments. These results have attracted considerable attention, and are among the best which have yet been obtained in Europe.

For about a year past, the Austrian government has been considering the matter of making arrangements with the International Electric Company and the Redlich and Berger firm for the electrification of the Trieste-Opcina section of the state railroads. At present the question is nearing a conclusion, according to the most recent reports. The Arad-Hegyaljer Railroad is to change over from the steam to the electric system in the near future.

A large turbine plant is being erected in Switzerland by the municipality of Zurich. It is located near Sils in the Grisons canton. The barrage will afford an artificial lake having some 420,000 cubic meters water storage. In the plant there are to be used eight main turbine and alternator sets of 2,000 kilowatts each. The machine voltage of 7,000 volts is raised by a bank of transformers to 40,000 volts for the power line, this latter being eighty miles in length. It is expected to finish the plant during the present year. A. DE C.

EASTERN CANADA.

(Special Correspondence.)

OTTAWA, JULY 3.—Sir Sandford Fleming, of Ottawa, the most eminent authority in Canada on telegraph cables, has left for England to consult with the Hon. Henniker Heaton regarding cheaper cable communication between Great Britain and the overseas dominions of the empire.

T. C. Fellowes, of Toronto, the last member of the Smith-Verry-Chase party, who have been surveying the dams, power house and transmission line from Matebetchewan to Cobalt, has gone to North Bay, Ontario, for which place the firm has undertaken the work of surveying the power line from dams, power house and right-of-way for a proposed new power line from Powassan. The power will be brought a distance of twenty miles to the city, and it is expected that the company will be able to transmit electric energy some time near the end of the present year.

Reports received at the department of public works, in this city, indicate that satisfactory progress is being made with the extension of the government telegraph line from Athabaska Landing westward to Lesser Slave Lake. During the past winter the poles were cut for the entire distance, and last month work was begun on erecting the poles and stringing wires. Notwithstanding heavy rains, that greatly impeded transportation of material, the first twenty miles had been completed on the 18th of June. The report states that hot, dry weather then set in so that even better progress on the work was anticipated. The Dominion government has already in operation telegraph lines from Edmonton to Athabaska Landing, a distance of 100 miles.

Sir Wilfrid Laurier has received a communication from the British Minister to Sweden, giving details as to the establishment of an electric smelting plant at Trollhatten Falls in that country. This work, which is on the model of the one at Domnarfvet, makes three commercial plants now in operation in Scandinavia, two in Sweden and one in Norway. The new Trollhatten plant has three furnaces, each of 2,500 electric horsepower, and a capacity of 7,500 tons of pig iron. The cost of the electric energy will be $7.50 per horsepower for the first ten years, and rising to $10 in the second ten years. The ores treated there carry percentages of phosphorus ranging from 4-10 to 1 9-10. The iron deposits of Ontario and Quebec, and particularly in the valleys of the Ottawa and Gatineau rivers, present this very peculiarity, so that Dr. Haanel, chief of the mines department of Canada, is extremely sanguine as to the feasibility of the establishment of an iron industry in Central Canada. He is making an examination of the iron ores of this section of the Dominion in view of the disclosures in the Swedish experiments. A. V. W.

IMPORTANT DEVELOPMENTS.

(Special Correspondence.)

CONNECTICUT COMPANY TO BUILD POWER PLANT—The Connecticut Company, the New York, New Haven & Hartford Road's trolley corporation, is planning the erection of a large power station to supply current to the trolley systems of Waterbury, Bridgeport and New Haven and their suburban connections. It is understood that the new plant will cost from $400,000 to $500,000. The site favored is on the Naugatuck River, Waterbury, and an application has been made to the Board of Aldermen for permission to dam the river near the present distributing station of the company. This plant has nothing to do with the electrification of the steam road from Stamford to New Haven and will be devoted entirely to trolleys.

CHAPALA POWER AND IRRIGATION COMPANY—Manuel Cuesta, of Guadalajara, who is at the head of the Chapala Power and Irrigation Company, which has just been organized in the City of Mexico, Mexico, with a capital stock of $8,000,000 Mexican money, says that the hydroelectric plant which the company will construct for the purpose of providing water for irrigation will cost more than $2,000,000. It is probable that two of these power plants will be built—one to be located on the Santiago River near Guadalajara and the other on a stream that empties into Lake Chapala. Transmission lines will be built to operate the pumps which will be located upon the shore of Lake Chapala, the water of which will be used to reclaim 75,000 acres of land. The government loan of $3,000,000 which was recently made to the company is secured by a lien upon the land that is to be reclaimed on a basis of $250 per hectare. An additional loan of $2,000,000 has been made the company by the Caja de Prestamos, or Loan Bank, of this city. This money will be used to build about 110 miles of main irrigating canals, and to establish three pumping stations. While the first unit of this gigantic system of irrigation will provide for the reclaiming of 75,000 acres of land, the plans when completely rounded out will involve the irrigation of more than 500,000 acres. The Pimental interests of the City of Mexico, which own the street railway, light and power systems of Guadalajara, are associated with Mr. Cuesta in the big enterprise. W. D. H.

LIGHTING AND POWER.

(Special Correspondence.)

KONAWA, OKLA.—The city has voted $35,000 water and light bonds.

SOUTH BETHLEHEM, PA.—The Halcyon Electric Light Company is installing a new plant.

BLACKWELL, OKLA.—This city is to issue bonds for the construction of an electric-light plant.

STORY CITY, IOWA—It has been voted to bond the city for the purchase of the electric-light plant. C.

SUTTON, NEB.—An election will be held July 23 to vote on electric-light and waterworks bonds to the amount of $39,000.

BARTLESVILLE, OKLA.—The Bartlesville Light and Power Company has been incorporated with a capital stock of $200,000.

ROCHESTER, MINN.—Owing to mismanagement, presumably, the municipal electric-light plant is running behind about $8,000 a year. C.

SAN JUAN, CAL.—A franchise has been granted the San Benito Light and Power Company to extend its lines through the town.

McMINNVILLE, ORE.—At a bond election held in this town last week $30,000 was voted to complete the municipal electric-light plant.

NOBLESVILLE, IND.—The Noblesville Heat, Light and Power Company has increased its capitalization from $50,000 to $70,000 for the purpose of making extensions and improvements to the

plant. Thos. C. Reynolds, president, and Alex. C. Holliday, secretary. S.

NEVADA COUNTY, CAL.—The management of the Snowden Hill Mine is to install a number of machine drills and an electric-lighting plant. U.

DES MOINES, IOWA—The Downing Electrical Supply Company, of Fort Dodge, Iowa, will establish an electrical supply jobbing house in this city. C.

SEATTLE, WASH.—The City Council has passed resolutions providing for the installation of additional street lights on certain thoroughfares within this city.

ROUNDUP, MONT.—The Roundup Coal Mining Company expects to have its plant for supplying the city with electric light in running order by July 15. C.

BELLINGHAM, WASH.—The E. K. Wood Lumber Company is to erect an electric planing mill, construction of which is to commence in the immediate future. U.

FORT PIERCE, FLA.—The City Council has passed an ordinance granting a franchise to the St. Lucie Ice Company to construct an electric-light and power system.

TULIA, TEX.—The Tulia Light and Ice Company, recently reported incorporated with $10,000 capital stock, will erect a twenty-five by ninety-foot building for light plant.

BARTLESVILLE, OKLA.—The Bartlesville Light and Power Company has been incorporated with $200,000 capital stock by L. A. Rowland, S. J. Smallwood and R. L. Beattie.

WINONA, MINN.—N. M. Argabrite, of the Winona Railway and Light Company, has become superintendent of the combined electric-light, gas and heating plant at Belvidere, Ill. C.

PRICE, UTAH—A Salt Lake firm has submitted to the Price town board a proposition to install an electric-lighting plant for Price, on which the board will take action in the immediate future. U.

ATLANTA, GA.—The Electric Construction Company has applied for a charter, capital stock $12,000. Incorporators: Charles M. Coyne, W. M. Gregory, J. Prince Coyne and Carroll B. McGaughey. L.

WETUMKA, OKLA.—A proposition has been submitted to the City Council of Wetumka by the Franklin Construction Company, of St. Louis, which proposes to install a modern electric-light plant here. U.

BLACKWELL, OKLA.—The city is completing arrangements for proposed issuance of $58,000 of bonds for waterworks and sewer extension, electric-light plant and street improvements. A. Sparks, city clerk.

ST. HELENS, ORE.—The City Council has granted the McCormick Company the right to operate an electric lighting plant in this city. Machinery has been ordered and operation will begin as soon as the equipment can be installed.

BOULDER, COLO.—The Eastern Colorado Power Company is to expend about $5,000,000, and it will require something like five years to complete its work. The initial power plant, furnishing about 20,000 horsepower, will be installed this year. U.

BOSTON, MASS.—The Gas Commission has approved of an issue of $40,000 twenty-year five-per-cent bonds by the Milford Electric Light and Power Company to cancel outstanding obligations and for additions.

SHERIDAN, WYO.—J. J. Henry, president of the Southern Colorado Power and Railway Company, of Trinidad, Colo., has made satisfactory arrangements for the purchase of the Sheridan Electric Light Company's plant and lines, and plans will be prepared at once for a power house.

LINDEN, WIS.—It is planned to install street and house lights here, current to be secured from Mineral Point, seven miles away. Banker John Harker is pushing the project. The original plan called for a generating station at Linden, but the overland transmission is now favored.

SPOKANE, WASH.—Sam Berry, J. B. Valentine and Sidney Berry, of the Columbia Water Power Company, have announced plans for the construction of a $50,000 power plant on the Methow River. A high-tension power line will be built to convey the power to Bridgeport, Brewster, Pateros, Methow and other towns in the vicinity.

LITTLE ROCK, ARK.—The secretary of state has granted a charter to the Garland Power and Development Company, the headquarters of which will be at Hot Springs. The company is capitalized at $1,500,000, with the following incorporators: Henry Dalhoff, president; P. J. Hannon, vice-president; J. A. Stallcup, treasurer, and Simon Cooper and George Belding, stockholders. It is proposed to build extensive dams and power plant on the Ouachita River, in Garland County, for the purpose of supplying electric current to points in adjacent counties.

JEFFERSON, OKLA.—The Jefferson Power and Improvement Company, recently reported incorporated with $100,000 capital stock, contemplates the development of 1,500 horsepower, with thirty miles of transmission line. The company will erect a concrete dam about twenty-five feet high and forty feet long; also a steel dam about 600 feet long.

SALMON, IDAHO—R. L. Edwards, of the firm of Brown & Edwards, mining engineers, who is manager of operations at the Kittie Burton Gold Mines Company, of Ulysses, has announced that the Kittie Burton people have in contemplation the erection of a large power plant, hydroelectric, to furnish power for operating the mill, light plant, and air compressors. U.

AUSTIN, TEX.—Attorney-General Davidson, acting on behalf of the state, has filed suit in the District Court, at Austin, against the Dallas Interurban Electric Railway Company for the forfeiture of its charter on the ground of insolvency, for the appointment of a receiver and for the cancellation of an alleged fictitious issue of stock amounting to $2,000,000.

GREEN CASTLE, IND.—W. S. Blatchley, state geologist, is conducting a survey of Eel River through this county, where the banks are high, for the purpose of ascertaining the power possibilities. It is believed the source of water supply in Eel River is sufficient to warrant the construction of dams and the installation of plants for the generation of electricity to be transmitted to the adjacent cities and towns. S.

MINNEAPOLIS, MINN.—The Minneapolis General Electric Company has commenced negotiations with the City Council with a view to settling the dispute over the price to be paid for street lights. The company will offer to supply these lights at seventy dollars each per annum, the amount provided for in the Council resolution, if the Council will make satisfactory settlement for the unpaid bills for this service. C.

PIQUA, OHIO—The Orr Felt and Blanket Company has awarded the contract for a new mill, to cost $75,000, exclusive of machinery or its installation, which will bring the total cost up to $200,000, to be built in this place. The contract calls for the completion of the structure by January 1, 1910. The company is making government army blankets. All the power for the new mill will be electrical, generated within the plant.

LEWISTON, ME.—The Union Water Power Company has secured control of the waterpower privileges of the International Paper Company, on the Androscoggin River, for a distance of six miles between what is known as the Babbitt & Googin dam and the Turner Center bridge. Between these two points, which are from five to eleven miles above this city, there is a fall of forty-four feet, and it is capable of developing over 10,000 horsepower.

NEVADA CITY, CAL.—The Middle Yuba Hydro-Electric Power Company has been incorporated here with a capital stock of $400,000 by A. D. Foote, C. M. Wilson, W. H. Martin, L. M. Hancock, L. N. Wagner, C. T. Jones and Dr. A. H. Tricknell. The company has rights on the Middle Yuba River above Graniteville, where a power house will be built. The company plans to distribute power to the mines and towns of Nevada and Sierra counties.

YREKA, CAL.—Harvey J. Sarter has completed the survey of the new power line of the Siskiyou Electric Light and Power Company from the Fall Creek power house as far as Sisson, a distance of fifty-five miles. The company is extending the south end of the Fall Creek power house to accommodate another 1,000-kilowatt generator. The poles, wire and insulators are now at Ager, Montague, Weed and Sisson, ready for distribution along the line.

PHŒNIX, ARIZ.—The articles of incorporation of the Arizona Orange-Land Water Association have been filed with the territorial auditor. Negotiations have been tentatively closed with the Pacific Gas and Electric Company to furnish the necessary power. The Pacific will extend its power line to Glendale, and the beet factory, and from there a power line will be run to the lands of the association. Frank L. Wright is president of the new company. U.

CHARLOTTE, N. C.—The large new mill to be projected at Roanoke Rapids will be a $500,000 enterprise. Organization will be effected, with the Patterson Mills as the title. Sam F. Patterson, treasurer of the Roanoke Mills Company and the Rosemary Manufacturing Company, both of Roanoke Rapids, is the principal promoter. The equipment will consist of 20,000 spindles and 750 looms on the production of ginghams. Electric power will be used.

REDDING, CAL.—E. V. D. Johnson, manager of the Northern California Power Company, Consolidated, says that the new plant at South, with a capacity of 6,000 horsepower will be completed and ready to furnish power early in July. After this, work is to be started at the Inskip plant, where 8,000 horsepower will be developed, and at the company's main Battle Creek plant, where it is planned to develop 24,000 horsepower. It is expected to have this completed before the end of 1910. The company has

just secured additional water rights and property by the purchase of the C. W. Hamilton ranch and water rights east of Redding.

MODOC, S. C.—The Twin City Power Company, Thomas O'Connor, president, 54 Broad Street, Waterford, N. Y., has begun the construction of a waterpower-electric plant. The company will construct a steel dam with concrete, sixty feet high from mean low water; initial development, 26,000 horsepower; final development, 46,000 horsepower; total cost, $4,000,000; constructing engineer, Ambursen Hydraulic Construction Company, 176 Federal Street, Boston, Mass.

CHATTANOOGA, TENN.—Electricity is now being supplied to Chattanooga from the new power plant at Hale's Bar, where the great lock and dam is being constructed, seventeen miles from this city. The plant will furnish 56,000 horsepower. The power is sufficient for all uses for a city many times as large as Chattanooga. The completion of this lock and dam will result in the opening of the Tennessee River to navigation as far as Chattanooga the year around.

LOS ANGELES, CAL.—The Los Angeles Gas and Electric Company has reorganized, substituting the word "corporation" for "company" and increasing its capitalization to $30,000,000. The incorporators are W. B. Cline, C. S. Vance, C. A. Luckenbaum, T. P. McCrea, W. E. Houghton, H. R. Austin and C. P. Houghton. Within ninety days an offer for the Pasadena Consolidated Gas and Electric Company will be made, and eventually all the minor plants about Los Angeles are planned in the merger.

CHESTER, S. C.—The Southern Power Company's current has just been turned on in Chester, where the Chester Light and Power Company, a subsidiary corporation to the Southern Power Company, incorporated under the New Jersey laws, has taken charge of the city's lighting interests and the sale of power to several large manufacturing plants in and about Chester. The formal transfer of the property to the Chester company was arranged to take place as soon as the meter readings had been completed. L.

FORT WAYNE, IND.—The Indiana Lighting Company has let a contract to the Western Gas Construction Company for the installation of gas-producing machinery that will double the capacity of the company's local plant. When completed the capacity will be 2,500,000 cubic feet daily. The contract price is $50,000. The Indiana Lighting Company has also awarded a contract to the Kerr-Murray Manufacturing Company for the construction of large gas holders at Lebanon, Frankfort, Decatur and Lafayette. S.

HICKORY, N. C.—Following the reported opposition of the Thornton Light and Power Company to the entrance of the Southern Power Company into the town, an agreement has been perfected whereby the Thornton company will receive current from the second-named company, which will be permitted to enter Hickory with its extensive lines. The Thornton Light and Power Company held the lighting franchise, and this company will distribute power brought in by the Southern Power Company, it is stated now. L.

BOSTON, MASS.—The Massachusetts Electric Companies, through its subsidiary companies, has recently placed orders for forty semi-convertible cars, the purchase of which represents a total investment of about $200,000. These cars were ordered from the Laconia Car Company. All the new equipment of the Massachusetts Electric properties is now confirmed to this class of car, which can be used at all seasons of the year and does not necessitate the company buying summer equipment, which can be used only for about six months of the year.

HAMILTON, MONT.—Articles of incorporation have been filed in the office of the Ravalli county clerk and recorder by the Stevensville Light, Power and Improvement Company, which will begin the construction of an electric light system in Stevensville. The company is organized with a capital stock of $35,000, divided into 350 shares of $100 each. The organizers of the company are C. B. McCarthy of Helena, George T. Baggs of Stevensville, and W. H. Rager of Stevensville. The principal place of business of the new company will be at Stevensville.

NORTH ABINGTON, MASS.—The Electric Light and Power Company, of Abington and Rockland, has petitioned the board of gas and electric-light commissioners for the approval of the purchase of the property and franchises of the Cohasset Electric Company. The Cohasset Company furnishes light for Scituate as well as Cohasset, and it is the intention of the local company to light these towns from the big plant recently installed in East Bridgewater. The company recently added Hanover and Norwell to its circuit, and the system will be extended to Cohasset.

FRESNO, CAL.—Manager A. G. Wishon, of the San Joaquin Light and Power Company, will leave in a few days for a trip to Los Angeles to look over the plans for the extension of the power lines in this city. A survey at Crane Valley has been completed and a good portion of the ditch to convey water from the south fork to the middle fork of the San Joaquin River, has been finished. Equipment for the $50,000 dam is now being received and construction work will soon begin. The old power plant is to be increased from a capacity of 2,500 horsepower to a total of 17,000 horsepower.

ASHLAND, WIS.—The Ashland Light, Power and Street Railway Company has taken possession of the White River power plant. The deed of transfer is signed by E. A. Edmunds as president and C. A. Wixson as secretary of the White River power plant, and conveys to the Ashland Light, Power and Street Railway Company all the right, interest and title to the holdings of the White River Power Company. The transfer includes the flowage rights, dam and power house at White River, transmission lines and poles, substation at Ashland, and all rights granted the company by the state and others.

PHILADELPHIA, PA.—The Delaware County Electric Company, which is being incorporated to own and control four electric-light properties in Delaware County, Pa., has made a contract for its power supply with the Philadelphia Electric Company. There will be an issue of $300,000 first-mortgage bonds, which will be issued for extensions and improvements. Montgomery, Clothier & Tyler have underwritten and sold all of the bonds of this issue. The Delaware County Electric Company will be controlled by the Associated Gas and Electric Company of New York, a corporation controlling and operating fourteen gas and light properties in New York, Pennsylvania and Ohio.

ELECTRIC RAILWAYS.

(Special Correspondence.)

NEW YORK, N. Y.—The New York, Westchester & Boston Railroad is at work on the construction of that portion where it crosses the New Haven road at New Rochelle. Nearly all of the right-of-way from the terminus of the Lenox Avenue subway at One Hundred and Seventy-seventh Street to New Rochelle has been contracted for or purchased, and work on the entire road will probably be begun by the middle of July.

SPOKANE, WASH.—President Robert E. Strahorn, of the North Coast Railway Company, announces that his company is developing a plant in the Cascade Mountains which will generate electricity for operating the road over the summit. A contract has been let for sixteen miles of grading, which will carry the line to within eight miles of North Yakima. Flumes over eight miles in length will carry water from the Cowlitz River providing an 800-foot fall, able to generate some 30,000 horsepower.

TOLEDO, OHIO—C. R. McKay, who for the past two years has been manager of the electric-lighting and heating departments of the Toledo Railways and Light Company, at Toledo, has tendered his resignation, to take effect on July 1. Mr. McKay will become general manager of the Union Light, Heating and Power Company, of Covington, Ky., one of the largest plants in the country, and furnishing light, heat and power for seven cities. The vacancy which has been caused by his resignation has not yet been filled. H.

REDWOOD CITY, CAL.—The Sierra and San Francisco Power Company has filed articles of incorporation here, the capital stock being placed at $20,000,000. The incorporators are all connected with the office of Chickering & Gregory, of San Francisco, attorneys for the United Railroads in the matter of the absorption of the Stanislaus Electric Power Company and its allied corporations. It is understood that the new incorporation marks another step in the consolidation of the railway and power companies.

SEATTLE, WASH.—Construction of the Tacoma-Seattle Short Line will be resumed immediately and will be completed within a year, according to plans perfected at a reorganization of the company. To this end a contract has been entered into with H. A. Eastman, of Detroit, and E. J. Felt, of Tacoma, to finance and construct the line. Mr. Felt was chosen because of his success in financing and building the Pacific Traction Company's lines at Tacoma. Funds are being raised through the sale of $3,500,000 in bonds.

MINNEAPOLIS, MINN.—An electric interstate railway providing connections between the Twin Cities and many points in southern Minnesota and Iowa is the latest project to receive the attention of the people living on both sides of the state boundary line. The distance from Jackson to Owatonna, where the Dan Patch Air Line would be joined for a route into the Twin Cities, is about 100 miles. It is practically the last stretch between the proposed Minnesota system and the system now long in existence in Iowa.

SYRACUSE, N. Y.—The New York State Railways, the new controlling corporation of the Vanderbilt-Andrews electric railway holdings, including the Rapid Transit of this city and the Oneida Railway, has applied to the Public Service Commission, Second District, for permission to increase its capital stock from $23,140,200 to $23,860,200; to purchase and acquire the stock of various street railroad corporations; to execute a first consolidated and refunding mortgage upon its property, rights and franchises to secure $35,000,000 of coupon or registered bonds, and to issue at present $6,500,000 in bonds under this mortgage. The

$6,500,000 of bonds to be issued are for the purpose of refunding the outstanding bonds of the Rochester & Eastern Rapid Transit Railway, to acquire the Rome City Railway Company bonds and the notes of these companies: Rochester & Suburban Railway, Syracuse Rapid Transit Railway, Utica & Mohawk Valley Railway, Ontario Light and Traction Company, Oneida Railway, Rochester Railway and Rochester & Eastern Rapid Railway.

MIDDLETOWN, PA.—At a special meeting of the stockholders of the Central Pennsylvania Traction Company, held at Harrisburg, a resolution was unanimously passed, authorizing a $2,000,000 loan for the improvement of the company's system and the construction of a new car barn on North Cameron Street. The bonds will be four-and-one-half per cent and $300,000 worth will be issued at once for use this year. Another matter that will now be taken up will be the extension of the Rockville line to Dauphin.

HARRISBURG, PA.—A charter has been granted to the Philadelphia Suburban Traction Company. This company will operate a line in Montgomery and Bucks counties. The company has a capital of $25,000, the incorporators being W. E. Watts, Dubois, president; John L. Grogan, H. C. Case and John A. Bonnell, Philadelphia, and W. A. Merrick, Newtown. The route set forth in the charter application is from Southampton, Bucks County, to Davisville, and then to Johnsville, ending at the borough line of Hatboro.

VALLEJO, CAL.—Captain Charles Hatch, of the Monticello Steamship Company; President W. Botsford, of the Vallejo & Napa Valley Electric Railway Company, and Superintendent McIntire, of the same company, have been in Lake County selecting a route for the proposed extension of the Vallejo & Napa Valley line into Lake County. The company's St. Helena-Clear Lake extension has now been surveyed as far as the Graystone Winery and construction will begin immediately, the rails and ties being now on hand.

AUSTIN, TEX.—The attorney-general has approved for filing an amendment to the charter of the Marshall & East Texas Railway Company, increasing its capital stock from $75,000 to $200,000, and providing for an extension. The road is now operated from Winnsboro, Wood County, to Marshall, and is the old Texas Southern property reorganized. It is proposed to extend south from Marshall through the counties of Harrison, Panola, Shelby, San Augustine, Sabine and Newton to the town of Newton, a total of 125 miles.

UVALDE, TEX.—The line of the Uvalde Street Railway Company, which connects the station of Uvalde with the town of Uvalde, a distance of three miles, is to be extended from Uvalde to Batesville, twenty miles, according to present plans. This line is operated by gasoline engines and is the only railway of its kind in Texas. It has proved very successful. The line does a heavy freight as well as passenger business. The contemplated line to Batesville will cover a territory now without railroad transportation of any kind. D.

HAILEYBURY, ONT.—Arrangements have been completed for the first electric railway in the north country. It is understood that all contracts have been signed and that work has virtually been commenced, so the people of Haileybury and Cobalt will soon be connected by a twenty-minute service, operated by an up-to-date electric railway. The company's directorate is made up of a number of Americans and Canadians, most of whom now have their residence in Cobalt or Haileybury. It is called the Nipissing Central Railway Company.

ALLENTOWN, PA.—The Allentown and Reading Traction Company announces big plans for extensions. It is to build lines to the Perkiomen Valley, including Lyons, Bowers and Trexlertown. From there another line will be built to Fogelsville and through the cement region there. This will open up a section of country to Allentown and Reading, which at the present time is cut off from trolley connections with these two cities. Their line will run through Alburtis, Hancock, Pennsburg and the many little towns down the Perkiomen.

AUBURN, N. Y.—The Public Service Commission has granted the application of the Geneva, Waterloo, Seneca Falls & Cayuga Lake Traction Company for permission to construct an extension of its railroad from Seneca Falls across Cayuga Lake to Auburn. The order requires that the detail plans for the crossing of Cayuga Lake be filed with and approved by the Commission before actual construction is commenced. The Commission has also granted the application of this company to change its name to Geneva & Auburn Railway Company.

HOUSTON, TEX.—The Galveston-Houston Electric Company will have completed the electric interurban line which it will build between this city and Galveston, a distance of fifty-one miles, in time to have the line in operation at the completion of the new reinforced concrete causeway across Galveston Bay. With the building of this causeway the railway will have a way of crossing the bay to the island upon which Galveston is situated. The company also expects to build branch lines to the different seaside resorts about Galveston. D.

SPOKANE, WASH.—It has been unofficially announced that Jay P. Graves, the president of the Spokane & Inland Empire Electric Railroad, which already has 239 miles of interurban road in operation besides its city traction service, has raised $7,000,000 on the company's bonds during his visit to the East, and that the company will expend all of this immense sum on improvements and betterments during the next twelve months. Among the admitted projects of the company is a branch line from the Palouse line to Colfax, a distance of twelve miles, and a thirty-eight-mile line through the big bend to the junction of the Spokane and Columbia rivers. U.

SAN FRANCISCO, CAL.—In pursuing the plan for the acquirement of mountain power rights and the construction and control of electric railways in California, E. H. Harriman has bought from Henry Hunt the electric power and electric railroad properties in and around the town of Fresno. The consideration, as approximately as can be ascertained, was $2,000,000, payable part in cash and part in Southern Pacific Company four per cent bonds. One of the properties purchased is the plant of the San Joaquin Power Company, in the mountains east of Fresno. Another property is the Fresno Electric Traction system, consisting of about twenty-two miles of road.

NASHVILLE, ILL.—The Nashville Interurban Railroad has been granted an amendment to its charter increasing the capital stock from $400,000 to $600,000. The object of the increase in stock is simply to cover the increased cost of the road over and above the first estimate of the division built, and to put it in first-class condition. The extension to Mt. Pleasant will begin probably during this year, but certainly within the next twelve months. The next division will be through to Mt. Pleasant, a distance of forty miles. But the management says that no extension will be attempted until the division already built is in first-class running order and as near perfect as it is possible to make it.

DES MOINES, IOWA—Articles of incorporation of the Iowa & Omaha Short Line Railway have been offered for filing in the office of the Secretary of State. The company is incorporated for $1,000,000. The railroad is a contemplated electric line between Des Moines, Council Bluffs and Omaha. It will run through Pottawattamie, Shelby, Audubon, Guthrie, Dallas and Polk counties, in Iowa, and Douglas County, in Nebraska, a total of 140 miles. Headquarters of the company will be at Pierre, S. D., in the office of John A. Holmes, but a business office will be operated at Walnut, Iowa. The incorporators of the company, with the exception of Holmes, are residents of Treynone, Adaira and Walnut.

BIG RAPIDS, MICH.—The town of Mason, Mich., must allow the Michigan United Railways to cross the city where it pleases on a private right-of-way. This is the decision of the Michigan Supreme Court, in which six justices agreed. Justice McAlvay dissented and Justice Hooker wrote a separate opinion, affirming, however, the decision of Judge Wisner, of Flint, in denying to the city a permanent injunction to restrain the company from crossing the city where it pleases. The decision is one of great importance to cities as well as to railways in Michigan, as the court holds that electric railways may incorporate under the general steam railway law for the purpose of forcing a route through a city on a private right-of-way, and then operate as an electric line.

GRAND RAPIDS, MICH.—Hodenpyl, Walbridge & Co., of New York, and E. W. Clark & Co., of Philadelphia, are promoting a consolidation of the Springfield Railway and Light Company, of Springfield, Ill., the Peoria Light Company, the Evansville Light Company, and the Rockford and Suburban Railway Company. The present companies are capitalized at $10,964,000 and bonds, $2,050,000 preferred stock and $8,000,000 common stock, and have net earnings of $687,188.05. The consolidation will be known as the Union Railway, Gas and Electric Company, and will be capitalized at $8,250,000, preferred stock on bond, and $6,000,000 common stock. Anthony G. Hodenpyl and Henry D. Walbridge are former residents of this city, and E. W. Clark is president of the Grand Rapids Railway Company. Mr. Hodenpyl was formerly secretary of the Michigan Trust and Savings Bank. His father was a well-known Dutch diamond merchant of New York.

PORTLAND, ORE.—President B. S. Josselyn, of the Portland Railway, Light and Power Company, has returned from the East with the announcement that improvements and extensions to the various departments of the service, aggregating $6,000,000, will be made this and next year. The budget for 1909 contemplates an outlay of $2,500,000 and, for 1910, $3,500,000. Items embraced in the current year's appropriations have all been announced, while the most essential expenditures for next year will be devoted to the construction of a $2,500,000 power plant, three miles above the present system at Cazadaro. With this electric plant and a new auxiliary steam station on the river north of The Oaks, the traction, light and power syndicate will have 100,000 of available horsepower for commercial and public-service usage. President Josselyn also stated that fifty new cars for the various lines of the street-railway division will be laid down here early in the fall.

OAKLAND, CAL.—Active work has been begun on the proposed Key Route extension along Sacramento Street, from the Oakland boundary line to the extreme northern section of Berkeley. A force of men commenced work this week on the grading of a private right-of-way in northern Oakland to connect the franchise route with the Adeline Street trunk line, near Fortieth Street. The company hopes to have the road in operation within sixteen months. Besides the trunk line on Sacramento Street, which will be five miles long and double track, the extension will include a single track line on Hopkins Street into the northern section of Berkeley and a single-track line through the new town of Ocean View to the Alameda County line at Richmond.

TOLEDO, OHIO—At a recent meeting of the Kenton, Ohio, Commercial Club the following trustees were elected, in whose names the right-of-way for the proposed Toledo-to-Columbus Interurban line will be securerd: J. W. Caine, H. E. Hoge, J. H. Allen, William J. Ochs, W. A. Norton. These gentlemen are representative business men, a number of them bankers of high standing. The club has given out the following communication, which was recently received from President Kerper, of the Toledo, Bowling Green & Southern: "If the right-of-way is immediately secured in Hardin and Hancock counties I will have cars running from Findlay to Kenton by January 1." A mass meeting of Kenton citizens was called and plans for securing the right-of-way outlined. W.

ALBANY, N. Y.—Application has been made to the Public Service Commission, Second District, by the New York State Railways, which has control of several up-state trolley companies, for permission to increase its capital stock from $23,140,200 to $23,860,200, to purchase the stock of various street-railway companies, to execute a first consolidated and refunding mortgage upon its property to secure $35,000,000 of coupon or registered bonds, and to issue at present $6,500,000 under this mortgage. The proposed increase is to be common stock, and with $674,700 of such increase it is proposed to purchase from the New York Central and the Central Railway Syndicate their holdings of stock of the Rochester and Suburban Railway Company, giving in exchange an equal amount of the new common stock at par.

RICHMOND, VA.—John R. McLean and Senator Stephen B. Elkins, of West Virginia, have purchased the Bluemont branch of the Southern Railway, which extends from Washington to Bluemont, Va. It is the plan of Messrs. McLean and Elkins to convert the road into an electric system and make it a part of the line which runs from Washington to Great Falls. The valuable falls of the Potomac River and the power plant are controlled by Elkins and McLean, and the power for the system will no doubt be generated from that point. The Bluemont-Washington branch is fifty-nine miles in length, and passes through the most beautiful part of Northern Virginia. Many persons who do business in Washington live on this road, and there has been great complaint that the fare by the steam road has been excessive and accommodations poor.

KANSAS CITY, MO.—It is reported that arrangements are all but completed for money to build a trolley line to Excelsior Springs and St. Joseph, a line which contemplates a new bridge across the Missouri. This is the enterprise in which Leslie M Shaw, of Iowa, formerly secretary of the treasury, is interested. "The line will be open for business within two years," one Kansas City banker stated. "Considerable work has already been done." When asked if there had been any deviation from the original plans to run to St. Joseph through Platte City, with a spur to Excelsior Springs, the banker said that there had been. "The changes are extensions, however. The present plans are to couple up the cities to the south and east. There will be an electric line to St. Louis before we stop building. The first thing, though, will be the completion of this trolley to St. Joseph."

RICHMOND, VA.—The proposed rehabilitation of the physical properties of the old Virginia Passenger and Power Company, now known as the Virginia Railway and Power Company, will be an extensive task. Among the extensions under consideration is the completion of the Richmond and Chesapeake Bay line on to Washington, thus affording the first electric-railway connection into the capital from the South, excepting the Baltimore line. In Richmond it is proposed to rebuild the system in accordance with the traffic demands of a growing town, curtailing some lines, and building new ones to whatever sections at the present time are wanting in electric-railway facilities. It is expected that work will be started at Ashland, the present terminus, and at Fredericksburg, also, on the Washington complete line. It is proposed to secure franchises between Broad and Main streets west of Beech street. Another issue is that of a bridge across the James River that will carry the weight of the Petersburg cars, twenty-eight miles distant, several sites having been examined, and with the lines to Washington and Petersburg, the Virginia Railway and Electric Company will have perhaps the longest system of lines in the southeastern states. L.

TELEPHONE AND TELEGRAPH.

(Special Correspondence.)

WACO, TEX.—The Texas Central Telephone Company has been incorporated with a capital stock of $6,000.

BURKE, S. D.—The Whitestone Valley Telephone Company has been incorporated with a capital stock of $5,000.

OGILVIE, MINN.—The Northwestern Telephone Exchange Company has been granted a franchise in this place.

SELBY, S. D.—The Walworth County Farmers' Telephone Company has been incorporated with a capital of $6,000.

CHOTEAU, MONT.—The Co-Operative Telephone Company of Choteau County has been organized with a capital stock of $40,000. C.

FLORENCE, MISS.—The Florence Telephone Company is installing poles, and will soon complete connection with the Cumberland lines.

LINCOLN, UTAH—The Progressive Telephone Company has been incorporated here with a capital stock of $5,450; J. W. Whitehouse is president.

SOUTH BEND, IND.—The South Bend Home Telephone Company will enter upon the work of expending $50,000 for extensions and improvement of its plant July 6. S.

SAN FRANCISCO, CAL.—The earnings of the Pacific Coast Telephone and Telegraph Company for May were over $1,000,000, the largest in the history of the company.

THOMPSON FALLS, MONT.—The Western Montana Telephone Company has been organized here with a capital stock of $12,500. Incorporators, A. S. Ainsworth and others.

FORT D. A. RUSSELL, WYO.—The contract for the construction of an electric-lighting plant for the fort has been let to the F. E. Newberry Electric Company, of St. Louis.

GLASGOW, MONT.—The Moore Telephone Company of this city has been incorporated with L. W. Gibson, president; R. G. Moore, vice-president, and C. O. Moore, secretary and treasurer.

STATESVILLE, N. C.—The Iredell Telephone Company, independent, has bought a site on which it is proposed to erect a telephone building fifty by forty feet, sufficient to meet all local demands for telephone service. L.

INDIANAPOLIS, IND.—Governor Marshall has ordered telephone companies to deny service to gambling houses or where pools are sold. If his orders are not complied with local authorities will be instructed to cut the wires. S.

PORTLAND, IND.—The Bell Telephone Company has sold its exchange and telephone property to the Portland Independent Telephone Company and will abandon the field. The taking over includes the Bell toll line business also. S.

ROCK HILL, S. C.—A deal has been completed for the overhauling and improvement of the local telephone system, R. M. Lewis, of Atlanta, being in charge of the work. The system will be put in modern shape, with new switchboards and the common battery system. L.

COLUMBUS, IND.—According to report the Bell Telephone Company, the Citizens' Telephone Company, the Hope Telephone Company and the Hartsville Telephone Company have been consolidated and will hereafter be operated under one management as an independent system. S.

MINNEAPOLIS, MINN.—C. E. Yost, of Omaha, president of the five recently combined western Bell Telephone companies, including Minneapolis, St. Paul and Duluth, has been perfecting the details of the consolidation. He says the company will spend $1,000,000 this year on extensions and betterments.

INDIANAPOLIS, IND.—The Indianapolis Telephone Company has entered upon the work of making improvements and extensions to its plant to cost half a million dollars. Considerable underground cable will be laid and the switchboards in at least three of the branch exchanges will be enlarged. S.

OMAHA, NEB.—The railway commission has authorized the Nebraska Telephone Company to reduce rates between South Omaha and Bellevue from fifteen cents to ten cents; Lincoln to Germantown, twenty cents to fifteen cents, and to publish a new rate between Albright and Gilmore and Sarpy of ten cents. C.

HOPE, IND.—The Hope Telephone Company's property and business has been sold to the Asby Brothers. The sale includes also the Hartsville plant. The new owners announce that they will go into the market soon and purchase material and equipment to improve and extend the plants into one large system. S.

MANSFIELD, ARK.—The Mansfield City Council, at its recent meeting, granted a franchise to the Boothe Telephone Company to enter and do business in Mansfield. It is the intention of the company to put in an up-to-date system. The company

is composed of citizens of Scott County who live at Boothe and vicinity.

PHŒNIX, ARIZ.—L. H. Chalmers, local attorney for the Consolidated Telephone and Telegraph Company, has received word from the president of the company, Colonel E. Randolph, that the company intends to improve its system and at an early date extend its line to Yuma and also to Kelvin and adjacent mining camps.

WICKLIFFE, IND.—The Patoka Telephone Company has filed articles of incorporation with the Secretary of State. The company proposes to build and equip a telephone system in Crawford and adjoining counties, with principal exchange in Wickliffe. Jacob Heeklenew, John Zimmerman and Ross Hamilton are the directors.

RICHMOND, VA.—The ordinance committee of the City Council has instructed the city attorney to prepare an ordinance to require the Southern Bell Telephone Company to improve its local system or surrender its charter. This action resulted from a discussion in the Council, several members alleging that the service was inadequate. L.

YONKERS, N. Y.—The New York Telephone Company, which operates in Yonkers, has taken over the Westchester division of the Hudson River Telephone Company, which has been covering the towns from Peekskill to Croton and from Briarcliff to Brewster. Several towns on the west side of the river, including Haverstraw, Nyack, Tappan and Spring Valley, also supplied with telephones by the Hudson River Company, are absorbed in this deal. In the district involved in the transfer there are about 5,000 instruments.

RALEIGH, N. C.—An important step has been taken by the Southern Bell Telephone Company here looking to the increase of rates in the cities of Asheville and Wilmington, N. C. The application has been filed with the state corporation commission, and that from Asheville is instituted by the Asheville Telephone Company, controlled by the Bell Company. It is asked that the company in the two towns named be permitted to increase rates to a basis equivalent to that in use at Charlotte and some other towns in the state. L.

ANACONDA, MONT.—At the annual meeting of the Independent Telephone Company the report showed that 4,088 telephones were in operation, as compared with 2,521 for the previous year. Long-distance connections have been established with Helena and Anaconda and between Butte and Billings. During the coming year the following additions will be made to the plant: Exchanges at Missoula, Stevensville, Hamilton and other points in the Bitter Root Valley; long-distance connections, Deer Lodge to Missoula, Missoula to Wallace and Missoula to Hamilton. C.

BLOOMFIELD, N. J.—The poles, conduits and franchises of the Bloomfield and Montclair Telephone Company have been sold at auction to James B. Curtis for $51,825. Mr. Curtis is a lawyer, living in Montclair, and is said to represent the bondholders of the company. The Fidelity Trust Company held a mortgage for $27,225 on the tangible assets of the Bloomfield concern, which was formed as an independent enterprise to serve Bloomfield, Montclair and East Orange. It is claimed by the mortgagee that the interest on the mortgage has not been paid since May 22, last.

NEW PUBLICATIONS.

STONE & WEBSTER, publishers, of Boston, Mass., announce that their "Current Literature References" on public utilities, etc. (construction, operation, finance), for 1908, are about ready for distribution. The edition is 500 copies, and it is desired that the gratuitous distribution of this pamphlet shall be to such libraries or persons as will be likely to find the references of decided use. The issue for 1908 is classified substantially the same as the preceding. References on conservation and water-power development are more abundant than in the previous issue, but the publishers wish it to be understood that all selections are made with a view to the interest of their business, and not with a view to being a complete engineering index.

ELECTRICAL SECURITIES.

Speaking generally, the stock market during the past week has been lifeless. This is on account of the holidays and also because of the absence of big dealers. From time to time many announcements of electrical securities offered the public appear in the daily press, and in all cases such issues are well received. The feature of the week in electrical finance has been the opportunity presented by the Commonwealth Edison Company of Chicago to its employes to obtain stock in the company on favorable terms at par over a period of five years. More extended mention of this is made in another part of this issue.

Boston & Northern Street Railway Company have declared the semi-annual dividend of three dollars per share on the preferred stock, payable August 1 to stock of record July 17. Brooklyn City Railroad declared the regular quarterly dividend of two-and-one-half per cent, payable July 15; books closed from July 1 to July 16. Consolidated Power Company of South Dakota has declared a regular dividend of one per cent on the preferred stock, payable July 1. Old Colony Street Railway has declared a semi-annual dividend of three dollars per share on the preferred stock, payable August 1, to stock of record July 17. Philadelphia City Passenger Railway Company has declared a semi-annual dividend of three dollars and seventy-five cents per share, payable July 10, to stock of record June 28; books closed June 28, and reopened July 12. Quincy (Ill.) Gas, Electric and Heating Company has declared a dividend of one per cent, payable July 20 to stockholders of record July 1; this is the second dividend, an initial dividend of one per cent having been paid in January last. Twin City Rapid Transit Company has declared a quarterly dividend of one-and-one-fourth per cent on the common stock, payable August 16 to stock of record July 21, 1909.

NEW YORK.

	July 5.	June 28.
Allis-Chalmers common	15⅛	14¼
Allis-Chalmers preferred	51¾	51¼
Amalgamated Copper	82⅝	81⅜
American Tel. & Cable	80*	80*
American Tel. & Tel.	140¾	141⅝
Brooklyn Rapid Transit	79½	79½
General Electric	164	161
Interborough-Metropolitan common	16½	17¼
Interborough-Metropolitan preferred	49⅜	51⅜
Kings County Electric	130	130
Mackay Companies (Postal Telegraph and Cables) common	79½	80
Mackay Companies (Postal Telegraph and Cables) preferred	73½	73⅞
Manhattan Elevated	143	142½
Metropolitan Street Railway	20	23
New York & New Jersey Telephone	124	133
U. S. Steel common	69¼	66⅜
U. S. Steel preferred	125⅛	123⅜
Western Union	72	72
Westinghouse common	84	85
Westinghouse preferred	..	123*

*Last price quoted.

BOSTON.

	July 5.	June 28.
American Tel. & Tel.	140¾	141⅝
Edison Elec. Illuminating	250	248
General Electric	164	161
Massachusetts Electric common	13¼	12
Massachusetts Electric preferred	71	68½
New England Telephone	134½	132
Western Tel. &. Tel. common	9¾	9¾
Western Tel. & Tel. preferred	87	86

PHILADELPHIA.

	July 5.	June 28.
American Railways	45¼	45¾
Electric Company of America	12½	12⅝
Electric Storage Battery common	52	52½
Electric Storage Battery preferred	52	52½
Philadelphia Electric	11¾	11⅞
Philadelphia Rapid Transit	28⅝	28¼
Philadelphia Traction	90¾	91
Union Traction	53	52

CHICAGO.

	July 5.	June 28.
Chicago Railways, Series 1	112¾	110
Chicago Railways, Series 2	40½	37½
Chicago Subway	22	24
Chicago Telephone	132	134
Commonwealth Edison	120	120
Metropolitan Elevated common	15½	17½
Metropolitan Elevated preferred	49	50
National Carbon common	91	92
National Carbon preferred	117½	117

PERSONAL MENTION.

CLARENCE H. MACKAY, president of the Mackay Companies, has returned from an European trip of two months.

PROF. H. A. WILSON, F. R. S., of King's College, London, has accepted the appointment of professor of physics in McGill University.

DR. W. H. TOLMAN, director of the Museum of Saefty and Sanitation, sailed on the Rotterdam last week to attend the International Medical Congress in Buda Pesth.

DR. CHARLES W. ELIOT, first president emeritus of Harvard University, had conferred on him by the university on June 30 the degrees of Doctor of Medicine and Doctor of Laws.

W. H. MAW, co-editor with B. A. Raworth of *Engineering*, of London, and a well-known engineer, has been made a Doctor of Laws by the University of Glasgow. Dr. Maw is a member of the Institution of Civil Engineers, and a past-president of the Institution of Mechanical Engineers.

JOSEPH H. WILLIAMSON, who for many years has been connected with the Manufacturers' Advertising Agency, of New York, and the Viennot Advertising Agency, of Philadelphia, Pa., as business manager, has opened an office at 719 Temple Court, New York city, as a representative of trade journals. He is well

known by publishers of trade papers for his honesty and integrity and has made a host of friends all over the United States.

FRANK J. GOULD, of Tarrytown, N. Y., has been named as the president of the Virginia Railway and Power Company in its petition for incorporation.

MORGAN BROOKS, professor of electrical engineering at the University of Illinois, Urbana, Ill., has been granted leave of absence for a year and expects to sail for Europe in October. He will spend three months in Europe and continue on a tour of the world. Mrs. Brooks will accompany Professor Brooks.

N. M. ARGABRITE, who for the past five years has filled the positions of superintendent and later general manager of the Winona Railway and Light Company, of Winona, Minn., has resigned. Mr. Argabrite's resignation is for the purpose of accepting the general managership of the Public Service Operating Company, of Belvidere, Ill., which position he enters into on August 1.

W. J. LLOYD, after thirty-eight years of almost continuous service, has assumed the office of first district superintendent of the Western Union Telegraph Company at Chicago, left vacant by F. H. Tubbs, retired. Mr. Lloyd, when he was twelve years of age, started as messenger boy in the office of the Western Union at Dubuque, Iowa. Here he learned the Morse code and shortly after took a position as operator with the Illinois Central Line. Later he rejoined the forces of the Western Union at Milwaukee, from which place he was sent to take charge of the joint offices of the Western Union and old Northwestern Telegraph companies at McGregor, Iowa. In 1877 Mr. Lloyd came to Chicago as chief operator of the telegraph rooms in the central offices and has been here since as manager, wire and division chief and assistant superintendent. F. H. Tubbs, the retiring superintendent, is one of the most widely known telegraph men in this country.

PROPOSALS.

POST OFFICE, BELVIDERE, ILL.—The office of the Supervising Architect, Washington, D. C., will receive sealed proposals until 3 o'clock p. m., August 9, for the construction (including plumbing, gas piping, heating apparatus, electric conduits and wiring) of the United States Post Office at Belvidere, Ill., in accordance with drawings and specification, copies of which may be obtained from the custodian of site at Belvidere, Ill., or at the Supervising Architect's office.

POST OFFICE, SHENANDOAH, IOWA—The office of the Supervising Architect, Washington, D. C., will receive sealed proposals until 3 o'clock p. m., July 21, for the construction (including plumbing, gas piping, heating apparatus, electric conduits and wiring) of the United States Post Office at Shenandoah, Iowa, in accordance with the drawings and specifications, copies of which may be had from the custodian at Shenandoah, Iowa, or at the Supervising Architect's office.

POST OFFICE, PLATTEVILLE, WIS.—The office of the Supervising Architect, Washington, D. C., will receive sealed proposals until 3 o'clock p. m., July 26, for the construction (including plumbing, gas piping, heating apparatus, electric conduits and wiring) of the United States Post Office at Platteville, Wis., in accordance with drawings and specifications, copies of which may be obtained from the custodian of site at Platteville, Wis., or at the Supervising Architect's office.

POST OFFICE AND COURT HOUSE, BOWLING GREEN, KY.—The office of the Supervising Architect, Washington, D. C., will receive sealed proposals until 3 o'clock p. m., August 4, for the construction (including plumbing, gas piping, electric wiring and conduits, and standard clock system) of the United States Post Office and Court House at Bowling Green, Ky., in accordance with the drawings and specification, copies of which may be had from the custodian of site at Bowling Green, Ky., or at the Supervising Architect's office.

POST OFFICE AND CUSTOM HOUSE, EAGLE PASS, TEX.—The office of the Supervising Architect, Washington, D. C., will receive sealed proposals until 3 o'clock p. m., August 2, for the construction (including plumbing, gas piping, heating apparatus, electric conduits and wiring) of the United States Post Office and Custom House at Eagle Pass., Tex., in accordance with drawings and specifications, copies of which may be had at the office of the custodian of the site at Eagle Pass, Tex., or at the Supervising Architect's office.

POST OFFICE AND COURT HOUSE, OWENSBORO, KY.—The office of the Supervising Architect, Washington, D. C., will receive sealed proposals until 3 o'clock p. m., July 27, for the construction (including plumbing, gas piping, heating apparatus, electric conduits and wiring, and a standard clock system) of the United States Post Office and Court House at Owensboro, Ky., in accordance with the drawings and specifications, copies of which may be had from the custodian of site at Owensboro, Ky., or at the Supervising Architect's office.

INDUSTRIAL ITEMS.

THE HOLTZER-CABOT ELECTRIC COMPANY, Brookline, Mass., has issued a copy of the "Continental Wireless Code," printed on thick card, suitable for hanging.

THE GENERAL ELECTRIC COMPANY has recently distributed Booklet No. 3779, containing a list of this company's snap switches. It will be of decided interest to the trade.

THE STANDARD UNDERGROUND CABLE COMPANY, Pittsburg, Pa., announces that it has changed its San Francisco office address from the Shreve Building to the First National Bank Building.

THE KUHLMAN ELECTRIC COMPANY, Elkhart, Ind., announces that it has opened up offices at 30 Greenwich Avenue, New York city, where all orders for the well-known Kuhlman transformers will be given immediate attention.

THE GOLDSCHMIDT THERMIT COMPANY, New York city, has issued the second quarterly number for 1909 of its interesting publication, *Reactions*, which contains instructive illustrated articles relating to the well-known thermit welding process and its successful applications.

FRED J. POSTEL and HOMER R. LINN, for many years associated as Postel & Linn, consulting engineers, Fisher Building, Chicago, announce that by mutual consent their partnership was dissolved on June 15, and that each member of the firm will continue in business individually as a consulting engineer.

THE HOLOPHANE COMPANY, New York city, has issued the June number of its publication, "Holophane Illumination," calling attention to the new bulletin, number 51, which promises much illuminating engineering data. It also contains an interesting article on the installation of Holophane glass in a steel mill.

THE NATIONAL ELECTRIC LAMP ASSOCIATION, through its Engineering Department, distributed to those attending the recent Atlantic City convention of the National Electric Light Association, a very conveniently arranged booklet of thirty pages, giving valuable data upon carbon, Gem, tantalum and tungsten incandescent lamps.

ROTH BROS. AND COMPANY, Chicago, Ill., have secured the contract for eleven new motors for use in the new plant of the Sanitary Laundry Company of Chicago. Some of the motors are for direct-connection to mangles and other machines and some are for belt driving through shafting. Postel & Linn, of Chicago, were the engineers for the Sanitary Laundry Company.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Rochester, N. Y., is sending out an imposing message to the trade in the form of a large folder devoted to the excellencies of the firm's improved compact type magneto wall telephone. The folder is nicely illustrated and gives necessary details in particular in regard to the "knock-down" features of this telephone.

THE LORD ELECTRIC COMPANY, of 213 West Fortieth Street, New York city, announces that it has just secured a contract for nearly $500,000 worth of its well-known products from an important electric-railway system. Among the items includel in the contract are third-rail feeders and structural work, laminated soldered rail bonds and various other materials used in the construction work.

THE ELECTRO-MECHANICAL ENGINEERING BUREAU has opened offices in the Monadnock Block, Chicago, where, with a well-trained staff of engineers, it is prepared to undertake experimental work and designing along various technical lines. Special laboratory facilities are available for conducting accurate and expeditious electrical, mechanical and chemical tests, as well as for extended research work.

THE GENERAL ELECTRIC COMPANY is about to put out a bulletin devoted to Tungsten Economy Diffusers, which is the latest publication issued on this subject. The new bulletin, No. 4660, goes more into detail and contains illustrations of this diffuser in connection with fixtures of various designs. This publication will certainly be of interest to those contemplating the use of tungsten lamps.

THE NOVELTY INCANDESCENT LAMP COMPANY, Emporium, Pa., is meeting with a great deal of success in introducing its "Any Angle" tungsten lamp. This lamp is equipped with a spiral filament supported by a central anchor. This lamp is manufactured in all standard sizes, including four-candlepower, five-watt, 10, 20, 25 and 27½ sign-lamp sizes. The forty-watt bulb lamp is made in the same size bulb as the sixteen-candlepower carbon lamp.

THE A. A. AUTOMATIC MANUFACTURING COMPANY, New York city, has issued an attractive booklet, entitled "The Servant Problem Solved," describing three styles of automatic kitchen, which can be supplied for either direct or alternating current. Style No. 1 includes the driving apparatus, porcelain-enameled stand, portable electric cord and plug. No. 2 includes

driving apparatus, porcelain-enameled table top, stand, portable electric cord and plug. No. 3, similar to No. 2. The utensils include coffee grinder, butter churner, dough mixer, egg and cream beater, fruit press, potato peeler, ice-cream freezer, meat and food chopper.

THE TRUMBULL ELECTRIC MANUFACTURING COMPANY, Plainville, Conn., brings out monthly what it is pleased to call a "Magazinette" named Trumbull Cheer, its object being to give the trade a hunch for Trumbull material and a boost for everyone. Combined generator and feeder panels are the specialties. This little house organ is full of practical information and good sound business suggestions. The front-page cover will strike the attention at the outset.

THE COMMONWEALTH EDISON COMPANY, of Chicago, is disposing of several thousand G. I. arc lamps through its exclusive selling agents for second-hand equipment, the Power Equipment Company, Fisher Building, Chicago. There are many different types of these G. I. lamps on this list, some of them brand-new, others having been used only for a short time. This is an excellent opportunity for central stations to purchase lamps to fill in their stock at about one-third of the new price.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., has been distributing its price list and discount sheet for May, applying to the 1909 catalogue No. 26. Very complete and substantially bound it is greatly in request by the trade. Attention is directed in well-worded and adequately illustrated announcements to the "Opalux" reflectors, "Opalux" tungsten fixtures, "tungstolite" cluster fixtures, the tungstometer, high-tension drop-out span-crossing protectors and other equally well-known specialties of the company.

THE MOORE ELECTRICAL COMPANY has just finished an installation in the United States Government Bureau of Standards, Washington, D. C., consisting of two tubes of the Moore Light—one white and the other yellow. Various tests will be made, the most important of which, however, is to prove the claim that the average color values of the Moore white tubes are as nearly the equivalent of average daylight as will ever be obtained and that it, therefore, should be adopted as the standard light for color values.

THE STUDEBAKER AUTOMOBILE COMPANY, of South Bend, Ind., is erecting at the corner of Michigan Avenue and Twenty-first Street, Chicago, what will be one of the most elaborate and finely equipped automobile salesrooms and garages in this country. The building will be of solid concrete, seven stories high, with a frontage on Michigan Avenue of seventy-five feet and 175 feet on Twenty-first Street. It is expected that the building will be ready for occupancy about January 1, 1910. The Studebaker-Garford plant at Elyria is turning out 1,500 high-grade cars a year, the plant in Detroit is delivering 1,000 medium-priced cars every month, and the South Bend factory is turning out over 1,000 electric pleasure and commercial cars yearly.

THE ROBBINS AND MYERS COMPANY, Springfield, Ohio, has published two handsome pieces of fan literature. Booklet No. 72 is entitled "Constant Coolness with Robbins & Myers Standard Fans." Booklet No. 74 is entitled "Summer Comfort with Robbins & Myers Standard Fans." In each there are fine halftone illustrations of this company's line of bracket, desk, wall, oscillating; ceiling and electrolier fans for both alternating and direct current.

MACGOVERN, ARCHER AND COMPANY, 114-118 Liberty Street, New York, are sending out a little booklet to the trade giving a list of electrical and steam machinery, cars and equipment, second-hand, but in first-class condition in every respect and ready for immediate shipment. Dated July and superseding all other lists issued, the book is replete with bargains, from large interurban or single-truck closed cars to air compressors, including motors and dynamos of all kinds.

THE LACLEDE-CHRISTY CLAY PRODUCTS COMPANY, St. Louis, Mo., has issued a comprehensive circular dealing with the "Laclede-Christy" chain grate, with roller and dumping attachment. Clear and well-chosen cuts illustrate the workings of this self-feeding, self-cleaning, labor-saving grate, the particular advantages of which are succinctly set forth. It may be remarked that some of the best-known concerns in the county use these grates, and engineers and others interested should see that they have the circular by them.

THE NATIONAL ELECTRIC LAMP ASSOCIATION, Cleveland, Ohio, through its Engineering Department, has published a data booklet upon carbon, Gem, tantalum and tungsten incandescent lamps. This is to be distributed to all central stations, jobbers, dealers and consumers in behalf of the members of the National Electric Lamp Association. The booklet gives a list of the companies supporting the Association, a brief history of the organization, and a statement of the lines of effort of the various departments. Very complete data are given on the various types of lamps above enumerated, together with illustrations showing the various styles and sizes of lamp bulbs used with the different kinds of filaments.

Directory of Electrical and Allied Engineering and Scientific Societies.

(Published in the second issue of each month.)

ALABAMA LIGHT AND TRACTION ASSOCIATION. Secretary, Lloyd Lyon, secretary and auditor Mobile Light and Railway Company, 158 Government Street, Mobile, Ala.

AMERICAN ASSOCIATION OF ELECTRIC MOTOR MANUFACTURERS. Secretary, W. H. Tapley, 29 West Thirty-ninth Street, New York, N. Y.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. Secretary, L. O. Howard, Smithsonian Institution, Washington, D. C.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, Dr. J. W. Richards, Bethlehem, Pa.

AMERICAN ELECTROTHERAPEUTIC ASSOCIATION. Secretary, Dr. Albert C. Geyser, 352 Willis Avenue, New York city.

AMERICAN FOUNDRYMEN'S ASSOCIATION. Secretary, Dr. Richard Moldenke, Watchung, N. J.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, Ralph W. Pope, Engineering Societies Building, 29 West Thirty-ninth Street, New York city.

AMERICAN INSTITUTE OF MINING ENGINEERS. Secretary, Rossiter W. Raymond, 29 West Thirty-ninth Street, New York city.

AMERICAN MATHEMATICAL SOCIETY. Secretary, F. N. Cole, 50 West 116th Street, New York city.

AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION. Secretary, J. W. Taylor, Old Colony Building, Chicago, Ill.

AMERICAN ROENTGEN-RAY SOCIETY. Secretary, Dr. G. C. Johnson, 514 Bijou Building, Pittsburg, Pa.

AMERICAN SOCIETY FOR TESTING MATERIALS. Secretary, Prof. Edgar Marburg, University of Pennsylvania, Philadelphia, Pa.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Secretary, Calvin W. Rice, 29 West Thirty-ninth Street, New York city.

AMERICAN SOCIETY OF CIVIL ENGINEERS. Secretary, Charles Warren Hunt, 220 West Forty-seventh Street, New York city.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS. Secretary, A. P. Folwell, Flatiron Building, New York city.

AMERICAN STREET AND INTERURBAN RAILWAY ASSOCIATION. Secretary, B. V. Swenson, Engineering Societies Building, 29 West Thirty-ninth Street, New York city.

AMERICAN STREET AND INTERURBAN RAILWAY ACCOUNTANTS' ASSOCIATION. Secretary, H. E. Weeks, secretary and treasurer Tri-City Railway Company, Davenport, Iowa.

AMERICAN STREET AND INTERURBAN RAILWAY CLAIM AGENTS' ASSOCIATION. Secretary, B. B. Davis, claim agent Columbus Railway and Light Company, Columbus, Ohio.

AMERICAN STREET AND INTERURBAN RAILWAY ENGINEERING ASSOCIATION. Secretary, J. W. Corning, electrical engineer Boston Elevated Railway Company, Boston, Mass.

AMERICAN STREET AND INTERURBAN RAILWAY TRANSPORTATION AND TRAFFIC ASSOCIATION. Secretary, B. V. Swenson, Engineering Societies Building, 29 West Thirty-ninth Street, New York city.

AMERICAN STREET AND INTERURBAN RAILWAY MANUFACTURERS' ASSOCIATION. Secretary, George B. Keegan, 2321 Park Row Building, New York city.

ARKANSAS ASSOCIATION OF PUBLIC UTILITY OPERATORS. Secretary, J. E. Cowles, superintendent of lighting Hot Springs Light and Railway Company, Hot Springs, Ark.

ARKANSAS INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Charles F. Speed, Texarkana, Ark.

ASSOCIATION OF CAR-LIGHTING ENGINEERS. Secretary, G. B. Colegrove, Illinois Central Railroad, Chicago, Ill.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, D. L. Huntington, second vice-president and manager Washington Water Power Company, Spokane, Wash.

ASSOCIATION OF EDISON PURCHASING AGENTS. Secretary, J. W. Brennan, Edison Illuminating Company, Detroit, Mich.

ASSOCIATION OF ELECTRIC LIGHTING ENGINEERS OF NEW ENGLAND. Secretary, W. H. Cole, Waltham, Mass.

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS. Secretary, G. H. Winslow, Frick Building Annex, Pittsburg, Pa.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Secretary, P. W. Drew, Minnesota, St. Paul & Sault Ste. Marie Railroad, Chicago, Ill.

CALIFORNIA ELECTRIC RAILWAY ASSOCIATION. Secretary, L. E. W. Pioda, Oak and Broderick streets, San Francisco.

CALIFORNIA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, P. T. Whittier, Spencer, Cal.

CANADIAN ELECTRICAL ASSOCIATION. Secretary, T. S. Young, Toronto, Canada.

CANADIAN STREET RAILWAY ASSOCIATION. Secretary, Acton Burrows, 33 Melinda Street, Toronto, Ontario.

CENTRAL ELECTRIC RAILWAY ASSOCIATION. Secretary, A. L. Neereamer, Traction Terminal Building, Indianapolis.

CENTRAL ELECTRIC TRAFFIC ASSOCIATION. Secretary, J. T. Brittson, assistant claim agent Chicago, South Bend & Northern Indiana Railway Company, South Bend, Ind.

COLORADO ELECTRIC LIGHT, POWER AND RAILWAY ASSOCIATION. Secretary, J. C. Lawler, Colorado Springs, Colo.

CONNECTICUT STATE STREET RAILWAY ASSOCIATION. Secretary, F. W. Poole, Bridgeport, Conn.

ELECTRIC CLUB OF CHICAGO. Secretary, Wm. S. Taussig, 204 Dearborn Street, Chicago, Ill.

ELECTRIC CLUB OF CLEVELAND. Secretary, George L. Crosby, 1200 Schofield Building, Cleveland, Ohio.

ELECTRICAL CLUB OF CALIFORNIA. Secretary, Russell D. Holabird, Argonaut Hotel, San Francisco, Cal.

ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, George William Russell, Jr., 500 Fifth Avenue, New York city.

ELECTRICAL CONTRACTORS' ASSOCIATION OF STATE OF MISSOURI. Secretary, Charles J. Sutter, 1220 Pine Street, St. Louis, Mo.

ELECTRICAL TRADES ASSOCIATION OF CANADA, LIMITED. Secretary, William R. Staveley, Royal Insurance Building, Montreal, Canada.

ELECTRICAL TRADES ASSOCIATION OF CHICAGO. Secretary, Frederick P. Vose, Marquette Building, Chicago, Ill.

ELECTRICAL TRADES ASSOCIATION OF PHILADELPHIA. Secretary, E. A. Symmes, 810 Drexel Building, Philadelphia.

ELECTRICAL TRADES ASSOCIATION OF THE PACIFIC COAST. Secretary, Albert H. Elliott, Harding Building, San Francisco, Cal.

ELECTRICAL TRADES SOCIETY OF NEW YORK (Member National Electrical Trades Association). Secretary Franz Neilson, 80 Wall Street, New York city.

EMPIRE STATE GAS AND ELECTRIC ASSOCIATION. Secretary, Charles H. B. Chapin, 154 Nassau Street, New York city.

ENGINE BUILDERS' ASSOCIATION OF THE UNITED STATES. Secretary, J. I. Lyle, 39 Cortlandt Street, New York city.

ENGINEERS' CLUB OF PHILADELPHIA. Secretary, H. G. Perring, 1317 Spruce Street, Philadelphia, Pa.

ENGINEERS' SOCIETY OF MILWAUKEE. Secretary, W. Fay Martin, Milwaukee, Wis.

FLORIDA ELECTRIC LIGHT AND POWER ASSOCIATION. Secretary, G. F. Doig, Gainesville, Fla.

ILLINOIS INDEPENDENT TELEPHONE ASSOCIATION. Secretary, C. A. Camp, Henry, Ill.

ILLINOIS STATE ELECTRICAL ASSOCIATION. Secretary, H. E. Chubbuck, Ottawa, Ill.

ILLUMINATING ENGINEERING SOCIETY. Secretary, Preston S. Millar, Engineering Societies Building, 33 West Thirty-ninth Street, New York city.

INDEPENDENT TELEPHONE ASSOCIATION OF TEXAS AND LOUISIANA. Secretary, C. A. Shock, Sherman, Tex.

INDIANA ELECTRIC LIGHT ASSOCIATION. Secretary, Frederic Leslie, Muncie, Ind. Next meeting, August 18 and 19, French Lick Springs, Ind.

INDIANA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Allen J. Paylow, Rockport, Ind.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, Frank P. Foster, Corning, N. Y. Annual convention, Atlantic City, N. J., September 14-16.

INTERNATIONAL INDEPENDENT TELEPHONE ASSOCIATION. Secretary, A. C. Davis, Parkersburg, W. Va.

IOWA ELECTRICAL ASSOCIATION. Secretary, W. N. Keiser, Des Moines, Iowa.

IOWA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, W. J. Thill, Des Moines, Iowa.

IOWA STREET AND INTERURBAN RAILWAY ASSOCIATION. Secretary, L. D. Mathes, Dubuque, Iowa.

KANSAS GAS, WATER, ELECTRIC LIGHT AND STREET RAILWAY ASSOCIATION. Secretary, James D. Nicholson, Newton, Kan.

KENTUCKY INDEPENDENT TELEPHONE ASSOCIATION. Secretary, W. G. Turpine, Henderson, Ky.

MAINE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, M. E. Crow, Houlton, Me.

MAINE STREET RAILWAY ASSOCIATION. Secretary, E. A. Newman, 471 Congress Street, Portland, Me.

MASSACHUSETTS STREET RAILWAY ASSOCIATION. Secretary, Charles S. Clark, 70 Kilby Street, Boston, Mass. Meets second Wednesday of each month, except July and August.

MASTER CAR BUILDERS' ASSOCIATION. Secretary, J. W. Taylor, 390 Old Colony Building, Chicago, Ill.

MICHIGAN ELECTRIC ASSOCIATION. Secretary, A. C. Marshall, Port Huron, Mich. Annual convention, Detroit, Mich., August 17, 18 and 19.

MICHIGAN INDEPENDENT TELEPHONE ASSOCIATION. Secretary, A. A. Burch, Battle Creek, Mich.

MINNESOTA ELECTRICAL ASSOCIATION. Secretary-treasurer, B. W. Copperthwait, Faribault, Minn.

MISSISSIPPI ELECTRICAL ASSOCIATION. Secretary, J. Abbott, manager Jackson Electric Railway, Light and Power Company, Jackson, Miss.

MISSOURI ELECTRIC, GAS, STREET RAILWAY AND WATERWORKS ASSOCIATION. Secretary, Claude L. Clary, Sikeston Electric Light and Power Company, Sikeston, Mo.

MISSOURI INDEPENDENT TELEPHONE ASSOCIATION. Secretary, George W. Schwerer, Windsor, Mo.

MUNICIPAL LIGHTING ASSOCIATION OF MASSACHUSETTS. Secretary, J. C. Norcross, Reading, Mass.

NATIONAL ARM, PIN AND BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 41 Martin Building, Utica, N. Y. Annual convention, Toledo, Ohio, July 21-23.

NATIONAL ELECTRICAL TRADES ASSOCIATION. Secretary, Frederick P. Vose, 1343 Marquette Building, Chicago, Ill.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Secretary, Frank M. Tait, Dayton, Ohio.

NEBRASKA ELECTRICAL ASSOCIATION. Secretary, Frank McMaster, Beatrice, Neb.

NEBRASKA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, R. E. Mattison, Lincoln, Neb.

NEW ENGLAND ELECTRICAL TRADES ASSOCIATION. Secretary, Alton F. Tupper, 60 State Street, Boston, Mass.

NEW ENGLAND STREET RAILWAY CLUB. Secretary, John J. Lane, 12 Pearl Street, Boston, Mass. Meetings held on fourth Thursday of each month.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, Engineering Societies Building, 29 West Thirty-ninth Street, New York city.

NEW YORK RAILROAD CLUB. Secretary, H. D. Vote, 95 Liberty Street, New York, N. Y.

NEW YORK STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, R. Max Eaton, Niagara Falls, N. Y.

NORTHWEST ELECTRIC LIGHT AND POWER ASSOCIATION. Secretary, N. W. Brockett, Cataract Building, Seattle, Wash.

NORTHWESTERN ELECTRICAL ASSOCIATION. Secretary-treasurer, John E. Allen, manager Equitable Electric Light Company, Lake Geneva, Wis.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio. Annual convention, Toledo, Ohio, July 13-15.

OHIO INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Ralph Reamer, Columbus, Ohio.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL AND STEAM ENGINEERS. Secretary, David Gaehr, Schofield Building, Cleveland, Ohio.

OHIO STREET RAILWAY ASSOCIATION. Secretary, Charles Currie, Akron, Ohio.

OKLAHOMA ELECTRIC LIGHT, RAILWAY AND GAS ASSOCIATION. Secretary, Galen Crow, Guthrie, Okla.

OLD-TIME TELEGRAPHERS' AND HISTORICAL ASSOCIATION. Secretary, Frank J. Scherrer, 195 Broadway, New York city. Annual reunion, Pittsburg, Pa., August 17-19.

ORDER OF THE REJUVENATED SONS OF JOVE. Mercury, C. B. Roulet, Dallas, Tex.

PACIFIC COAST ELECTRIC TRANSMISSION ASSOCIATION. Secretary, Samuel G. Reed, Portland, Ore.

PENNSYLVANIA ELECTRIC ASSOCIATION. Secretary, Dr. Henry M. Stein, Harrisburg, Pa. Annual convention, Eagles Mere, Pa., September 8, 9 and 10.

PENNSYLVANIA STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, H. E. Bradley, 135 South Second Street, Philadelphia, Pa.

PENNSYLVANIA STATE STREET RAILWAY ASSOCIATION. Secretary, Charles H. Smith, Lebanon, Pa.

PIKE'S PEAK POLYTECHNIC SOCIETY. Secretary, E. A. Sawyer, Colorado Springs, Colo. Meetings, second Saturday of each month.

RAILWAY SIGNAL ASSOCIATION. Secretary, C. C. Rosenberg, Bethlehem, Pa. Next annual meeting, Louisville, Ky., October 12-14, 1909.

SOCIETY OF AUTOMOBILE ENGINEERS. Secretary, Alexander Churchward, 30 Church Street, New York city. Annual meeting, Chicago, August 5-7.

SOCIETY OF WIRELESS TELEGRAPH ENGINEERS. Secretary, C. E. Russell, Boston, Mass.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, Arthur L. Williston, Pratt Institute, Brooklyn, N. Y.

SOUTH DAKOTA INDEPENDENT TELEPHONE ASSOCIATION. Secretary-treasurer, E. R. Buck, Hudson, S. D.

SOUTHWESTERN ELECTRICAL AND GAS ASSOCIATION. Secretary, E. T. Moore, Dallas, Tex.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK. Secretary, J. H. Pardee, J. G. White & Company, New York city.

TEXAS INDEPENDENT TELEPHONE ASSOCIATION. Secretary, T. A. Gould, Ennis, Tex.

UNDERWRITERS' NATIONAL ELECTRIC ASSOCIATION. Secretary Electrical Committee, C. M. Goddard, 55 Kilby Street, Boston, Mass.

VERMONT AND NEW HAMPSHIRE INDEPENDENT TELEPHONE ASSOCIATION. Secretary-treasurer, E. B. Seeley, St. Johnsbury, Vt.

VERMONT ELECTRICAL ASSOCIATION. Secretary, C. C. Wells, Middlebury Electric Light Company, Middlebury, Vt.

VIRGINIA STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, B. L. Fisher, Rocky Mount, Va.

WESTERN SOCIETY OF ENGINEERS (Electrical Section). Chairman, William B. Jackson, 115 Adams Street, Chicago, Ill.; secretary, J. H. Warder, Monadnock Block, Chicago, Ill.

WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary, W. S. Boyd, 382 Ohio Street, Chicago, Ill.

WISCONSIN ELECTRIC AND INTERURBAN RAILWAY ASSOCIATION. Secretary, Clement C. Smith, president Columbia Construction Company, Milwaukee, Wis.

WISCONSIN INDEPENDENT TELEPHONE ASSOCIATION. Secretary, J. C. Crowley, Jr., Superior, Wis.

DATES AHEAD.

Ohio Electric Light Association. Annual convention, Toledo, July 13-15.

National Electrical Contractors' Association. Annual convention, Toledo, Ohio, July 21-23.

Maine Electric Association. Annual convention, Portland, Me., July 29-30.

Society of Automobile Engineers. Annual convention, Chicago, August 5-7.

Michigan Electric Association. Annual convention, Detroit, Mich., August 17-19.

International Association of Municipal Electricians. Convention, Atlantic City, N. J., September 14-16.

American Street and Interurban Railway Association. Annual convention, Denver, Colo., October 4-9.

RECORD OF ELECTRICAL PATENTS.

Issued (United States Patent Office) June 29, 1909.

926,088. ELECTRIC-CURRENT COLLECTOR. Andrew H. Angle and Leaddison R. Hecker, Philadelphia, Pa., assignors to Safety Electric Railway Construction Company. Filed July 13, 1907. A laterally movable truck has a bridge piece (carried by a vertical shaft) having sliding engagement with it, a current-collecting medium rotatably connected with the bridge piece, and a hand wheel rotatably mounted on the shaft for raising and lowering the collecting medium.

926,102. PRINTING-PRESS. George R. Cornwall, Rye, N. Y., assignor to American Planograph Company, New York, N. Y. Filed May 27, 1903. Renewed October 23, 1905. A rotary printing press has a flexible metal printing plate mounted on the cylinder, means for holding the plate on the cylinder while electrically insulating it therefrom, and a source of electrical energy in circuit with the plate.

926,114. ADJUSTABLE LAMP-HOLDER. Louis E. Hall, Chicago, Ill. Filed September 12, 1907. Describes an incandescent lamp-holder with a swiveling attachment and adjustable on a vertical standard.

926,128. ELECTROLYTE-CONDENSER. Ignacy Moscicki, Gambach, near Fribourg, Switzerland. Filed October 29, 1907. Has aluminum electrodes immersed in an electrolyte, an alternating-current working circuit in which the electrodes are included, and means for causing a flow of unidirectional current through the electrodes as anodes.

926,154. PANEL-BOARD. Hervey S. Walker and Hermon L. Van Valkenburg, Philadelphia, Pa., assignors to Walker Electric Company, Philadelphia, Pa. Filed July 17, 1908. Describes the details of a panel-board mounting.

926,162. TRANSMITTING DEVICE FOR TELEGRAPH OPERATORS. William C. Achgill, Oklahoma, Okla., assignor of one-half to Edward C. Fritz, Oklahoma, Okla. Filed November 30, 1908. A vibrating dot-making bar has a vibrating-spring circuit-connection with one of a pair of binding-posts to conduct electric current from this binding-post to the bar and to vibrate the same.

926,164. CIRCUIT-CONTROLLER. William L. Bliss, New York, N. Y. Filed August 4, 1904. An electrolytic valve is adapted to permit current to flow in an electric circuit in one direction and to prevent it from flowing in the circuit in the opposite direction, and an automatic switch has an operating magnet connected with the circuit and adapted to remove the valve from operative relation with the circuit while the current in the circuit flows in the former direction.

926,165. LIGHTING SYSTEM. William L. Bliss, New York, N. Y. Filed June 22, 1904. Renewed November 25, 1908. A storage battery and translating devices are arranged in circuit with a generator which is driven at a variable speed, and means are adapted to regulate the generator to confine its output within prearranged limits without interfering with

the ability of the generator to vary the output in accordance with changes in the loads.

926,175. SWITCHING APPARATUS. Merritt S. Conner, Rochester, N. Y., assignor to Stromberg-Carlson Telephone Manufacturing Company. Filed May 19, 1904. Means are provided whereby upon depression of one of a number of actuating buttons for moving a latch frame, to lock this button in its depressed position; also means for subsequently allowing actuation of the aforesaid button to actuate its switching mechanism with movement of the latch frame, and means for releasing an actuated button from its depressed position.

926,185. ELECTRIC WATER-HEATER. William E. Hayes, Omaha, Neb. Filed March 2, 1909. Describes the details of an electric heater interposed between a supply-pipe and a faucet.

926,188. HEATING DEVICE. Julian R. Holley, Bristol, and Everett D. Holley, Forestville, Conn. Filed September 8, 1908. The heating unit comprises a resistance ribbon wound flatwise into a series of successive convolutions which are separated from each other by uniform air spaces.

926,192. DYNAMO-ELECTRIC MACHINE. Louis J. Hunt, Rhyl, England. Filed June 22, 1906. Windings on either the stator or the rotor are adapted to permit the flow of currents producing magnetic fields of two different numbers of poles, and windings on the other have a number of parallel paths adapted to allow the flow of currents producing magnetic fields of different numbers of poles.

926,199. TOLL APPARATUS FOR TELEPHONE EXCHANGES. Sherwood J. Larned, Chicago, Ill., assignor to Western Electric Company. Filed July 7, 1902. Renewed April 3, 1905. Has a polarized actuating magnet, alternative mechanism actuated thereby, and a reversing switch at the substation controlling the connection of the magnet with the line, a signal at the central office, and means for displaying the same controlled in the movement of the switch, to indicate the condition thereof, a source of current at the central office, and a switch for applying current to the line to excite the magnet toll device.

926,202. IGNITER FOR GASOLINE-ENGINES. Daniel F. MacCarthy, White Bear, and Harry M. Darling, St. Paul, Minn., assignors to Darmac Commutator Company, St. Paul, Minn. Filed February 16, 1906. An electric igniter comprises a rotary part, a non-conducting disk carried thereby, a contact carried by the disk and extending through the side face of it, a non-conducting rocker arm pivotally supported upon the rotary part in contact with the side face of the disk, contacts extending slidably through the rocker arm and projecting from the face of it into the path of the contact carried by the disk, and contact springs bearing against the outer ends of the slidable contacts.

926,225. DYNAMO-ELECTRIC MACHINE. Joseph A. Williams, Cleveland, Ohio. Filed September 13, 1906. Describes the details of a magneto-electric machine.

926,236. ELECTRIC FURNACE. Jean Bouneau, Paris, France. Filed July 17, 1907. The electrodes are mounted on carriages movable on rails.

926,243. SYSTEM OF ELECTRIC-CIRCUIT CONTROL. Francis W. Clary, Pittsburg, Pa., assignor to Westinghouse Electric & Manufacturing Company. Filed September 9, 1907. In combination with a polyphase alternating-current supply circuit are a receiving circuit and a number of transformers interposed between the circuits, and a pair of double-throw switches for varying the voltage applied to the receiving circuit.

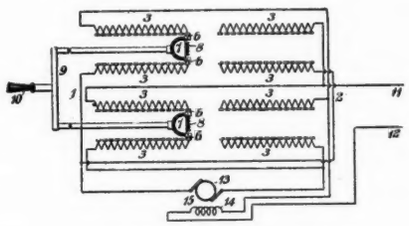
926,246. ELECTRIC OUTLET-BOX. Conrad J. Dorff, Chicago, Ill., assignor to Fredric Greer, Chicago, Ill. Filed April 6, 1908. An electric outlet box in two sections has means for securing the sections together comprising screws in opposite side walls of one section and slotted lugs rigidly fixed on the other section and extending in planes parallel with the side walls and adapted to be slipped beneath the heads of the screws.

926,247. MAGNETIC T-SQUARE. James C. Draper and Joseph W. Reid, Memphis, Tenn. Filed February 13, 1908. A drawing board has an iron strip applied to its edge and a T-square carries an electromagnet adapted to co-operate with the iron strip to hold the T-square in position.

926,248. DYNAMO-ELECTRIC MACHINE. Russell S. Feicht, Pittsburg, Pa., assignor to Westinghouse Electric & Manufacturing Company. Filed October 5, 1907. The core member has a number of slots with coils partially located in them, and magnetizable strips are insulated from the coils and from the core and disposed near the openings in the slots, and insulating wrappings are disposed around the strips and the corresponding coils.

926,251. HYDROSTATIC INDICATOR. George Harding, Coeur d'Alene, Idaho. Filed April 6, 1908. Means are provided for varying an electric current in accordance with the variation of fluid level, and an indicator responsive to the current variations is also included in the circuit; means under the control of the first-mentioned means are provided for closing another electric circuit at a predetermined change of fluid level, and an alarm circuit under the control of the second circuit is responsive only on the closure of the second circuit.

926,254. RHEOSTAT. Henry D. James, Pittsburg, Pa., assignor to Westinghouse Electric & Manufacturing Company. Filed July 17, 1905. Comprises two groups of resistance elements disposed in rectilinear alinement with each other and having their outer ends reversely connected to a translating device, and reciprocatory contact devices for connecting either group of resistance elements in circuit and for varying the number of active elements.



926,254.—RHEOSTAT.

926,258. TROLLEY-WIRE HANGER. Willard H. Kempton, Hartford, Conn., assignor to The Johns-Pratt Company, Hartford, Conn. Filed December 12, 1908. Comprises clamping plates, a supported toggle block located between the plates, toggle links carried by the block and adapted to draw the plates together, and a nut arranged to force the plates and the toggle in opposite directions, whereby the toggle will draw the plates together.

926,262. FIELD-MAGNET WINDING FOR DYNAMO-ELECTRIC MACHINES. Fred R. Kunkel, Edgewood Park, Pa., assignor to Westinghouse Electric & Manufacturing Company. Filed September 8, 1908. The field-magnet structure comprises a polar projection having a small body portion and an enlarged end portion the winding for which consists of a coil formed of a number of loops one or more of which are of less internal peripheral lengths than the enlarged portion of the polar projection and at least one of which is of greater internal peripheral length than the enlarged portion of the polar projection.

926,278. METHOD OF MAKING BATTERY-PLATES. George J. Miller, Toledo, Ohio. Filed August 27, 1906. Consists in scoring the plate at short distances apart to deflect the ridges of the transverse ribs.

926,284. ELECTRICAL APPARATUS FOR PRODUCING SOUND-SIGNALS. Charles H. O'Brien, Augusta, Me. Filed December 11, 1905. Comprises a sound-producing body, a diaphragm, a vibrating armature (provided with contacts) connected centrally of the diaphragm, an electromagnet for vibrating the armature, an electrical source of energy, and means for adjusting the electromagnet with relation to the armature.

926,312. METER-RELAY. Henry S. Baker, Wilkinsburg, Pa. Filed April 4, 1906. Has a pair of stationary contact members and a movable contact member provided with three magnetizable blocks and having its open circuit position between the stationary contact members; also a stationary magnet so located as to co-operate with the magnetizable block and thereby accentuate the positions which the movable member is adapted to occupy.

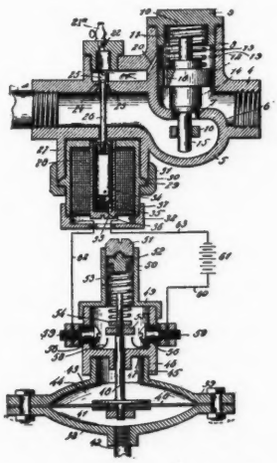
926,330. ELECTRIC IGNITION DEVICE. Theodore Hubert, New York, N. Y., assignor to Charles F. Splitdorf, New York, N. Y. Filed April 4, 1906. In combination with a magneto are an arm mounted to rock transversely with the armature axis, means to cause the arm to move in direction with the axis, a sliding part connected with the arm, and means to convert the sliding movement of this part into rotary adjustment of the magneto armature.

926,368. MAGNETO-ELECTRIC MACHINE. Ernst Troike, Sandusky, Ohio, assignor of one-fourth to Paul Troike, Sandusky, Ohio. Filed November 30, 1908. Describes the details of a magneto-electric machine.

926,369. MAGNETIC MOTOR. William H. Von Tish, Montclair, N. J. Filed September 16, 1907. Means are provided for de-energizing the magnets as the poles of the armature aline with the poles of the magnet.

926,372. PANEL-BOARD. Joseph J. Wesley, Hackensack, N. J., assignor to Metropolitan Switchboard Company. Filed April 7, 1909. A door adapted to close over the panel box has a concentrically located smaller hinged interior door which can be freely opened to uncover a restricted area of the panel board. Switches controlling the branch circuits of the panel board are located in this restricted area, and a pan overlying the switches is adapted to cover all the switches and the busbars of the panel-board when the inner door is opened.

926,386. ELECTRIC PRODUCTION-CONTROLLING DEVICE FOR FACTORIES. William H. Chappell, Chicago, Ill. Filed October 31, 1908. A signal board comprises a number of signaling devices arranged in rows and columns, the several rows being serially indicated and the several columns being distinctively indicated to correspond with the departments of the factory, and switchboards with electric switches thereon are provided for the several departments, so indicated, the several switches on each switchboard being electrically connected for controlling the several signal lamps in the column corresponding to the departments.



926,389.—ELECTRICALLY-OPERATED VALVE.

926,389. ELECTRICALLY-OPERATED VALVE. George W. Collin, Bridgeport, Conn. Filed February 23, 1907. Electrically operated means are provided for seating a supplemental valve to stop the flow to seat the main valve.

926,393. ELECTRICALLY-OPERATED PRICE-CARD. Percy L. Dirking, Spokane, Wash., assignor of one-sixth to Julian D. Miner and one-sixth to Joseph A. Pelkey, Spokane, Wash. Filed February 14, 1908. A magnetically operated mechanism actuates a reciprocating platform upon which is mounted a display member provided with legends to be brought successively into view; a contact mechanism is controllable by the movement of the platform, and electric lamps are connected with the contact mechanism and adapted to be lighted and extinguished thereby.

926,413. PROCESS FOR OXIDIZING ATMOSPHERIC NITROGEN BY ELECTRICITY. Demetrio Helbig, Rome, Italy. Filed January 7, 1908. Compressed air is projected by means of two opposite nozzles arranged in line against an arc produced by a three-phase current between three suitable electrodes arranged at an angle of 120 degrees relatively to each other, whereby a flame disk is produced which spreads out in a plane at a right angle to the axis of the nozzle.

926,426. COMBINED TABLE AND LAMP-STAND. Millard F. Koch and Monroe Koch, New York, N. Y. Filed February 24, 1909. The stand has a table adjustable thereon to different elevations and is composed of telescoping sections, and an incandescent lamp carried by the upper section is arranged to throw the light on the table.

926,433. ELECTRIC-FUSE BOX. Thomas E. Murray, New York, N. Y. Filed January 21, 1908. Parallel partitions, with pairs of metallic clips respectively on opposite sides, extend upwardly from the bottom of the box. Circuit terminals are connected to the clips and an upwardly swinging arm is pivoted between the partitions and connected to fuse cases having metallic terminals, and an upwardly swinging cover is pivoted to one end of the box and free from the arm.

926,437. AUTOMATIC BLOCK-SIGNAL FOR TROLLEY SYSTEMS. Pio N. Pecci, Paterson, N. J., assignor of one-half to Leon Lemieux, Paterson, N. J. Filed June 4, 1908. An electric motor moves first in one direction and then in the other to effect the "danger" and "safety" conditions of the apparatus.

926,445. ELECTROLIER HOLDER OR HANGER. John C. Vogel, Philadelphia, Pa., assignor to The Fairmount Electric and Manufacturing Company. Filed January 9, 1908. A chandelier or electrolier has a body the inner wall of which is roughened, a coupling member having a portion roughened to engage the roughened wall of the body, and cam members adapted to be adjusted to hold the coupling member rigidly in proper position.

926,451. CONNECTION TERMINAL FOR ELECTRIC CONDUCTORS. Herbert G. Addie, Cresco, Iowa, assignor to Arvid L. Peterson, Cresco, Iowa. Filed April 26, 1906. Has a metallic casing forming an inclosure for electrical conductors, and a one-piece terminal member having a hollow portion extending through the wall of the casing and a portion exterior of the casing extending out therefrom and adapted for a terminal for an external conductor.

926,507. ELECTRICALLY-OPERATED POINT-SHIFTING MECHANISM. Alfred Oesterreicher, Vienna, Austria-Hungary. Filed April 21, 1908. Comprises means for operating the switch points from a motor, means operative from the motor for causing a switch arm to traverse the two contacts of a circuit-closing switch, means for closing the circuit through either of the contacts and the switch arm, and means for closing the circuit during the travel of the switch arm when the circuit-closing contact of the latter is broken.

926,510. PARTY-LINE TELEPHONE SYSTEM. Homer J. Roberts, Evanston, and Cyril A. Soans and Albert H. Graves, Chicago, Ill., assignors to Homer Roberts Telephone Company. Filed January 8, 1907. Comprises means for sending differentiated current over a line wire extending through a number of substations and a selectively responsive ringer at each substation, a lockout relay at each substation, contact mechanism actuated and controlled by the relay, talking circuit connections including the contact mechanism, and controlling connections between the ringer and relay of each substation, whereby the operation of the relay is controlled through the ringer.

926,518. LIGHTING SYSTEM. William I. Thompson, Newark, N. J., assignor to Safety Car Heating & Lighting Company. Filed April 15, 1903. A shunt-wound generator has included serially in its field circuit a number of contacting electrodes and positively acting electromagnetic means controlled by the current output of the generator for varying the pressure with which the electrodes contact.

926,536. THERMO-EXPANSION METER. Clifford D. Babcock, New York, N. Y., assignor to The United Wireless Telegraph Company. Filed May 21, 1908. A hot-wire current meter includes a number of expansion elements, a switch adapted in one position to close the circuit through one of the elements and in another position to close the circuit through another of the elements, a pointer, and a scale for each of the circuits with which the pointer coacts.

926,584. ELECTRICAL SWITCH AND THE LIKE. David K. Morris and George A. Lister, Coventry, England. Filed September 22, 1908. The switch has a movable arm with contacts mounted on it, a laterally deflectable conducting strip rigidly connected at its ends with the contacts, and a fixed retaining piece with which the strip can co-operate for holding the arm in the closed position.

926,605. ELECTRIC BRAKE. Frank B. Rae, Detroit, Mich., assignor to Rae Electric Company. Filed January 10, 1906. In combination with a reservoir, brake cylinder, and a valve controlling communication between the same, are means for normally holding the valve with the ports closed, electric circuits controlling the valve, and means for regulating the circuits to actuate the valve.

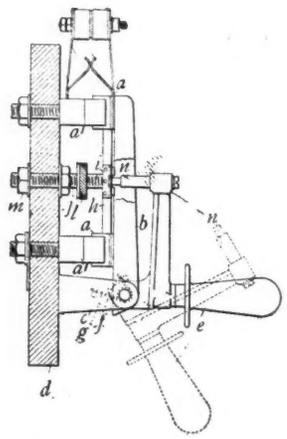
926,622. PENDENT ELECTRIC SWITCH. George B. Thomas, Bridgeport, Conn., assignor to Perkins Electric Switch Manufacturing Company. Filed March 23, 1906. A push-button pendent switch comprises an outer casing and an insulating cup-shaped body open at the top for the insertion of the switch mechanism, with binding-posts and spring clips at the top, switch mechanism inclosed in the body, and a sheet of insulation separating the binding-posts from the switch mechanism.

926,649. STORAGE BATTERY. John Stirlen and William Gardiner, St. Louis, Mo., assignors, by mesne assignments, to Missouri Electric Storage Battery Company. Filed February 11, 1909. The box-shaped receptacle has a removable cover for

one side, a number of transverse ribs in the bottom, battery members in the receptacle resting on the ribs, and bars between the battery members adapted to support the same in proper position in the receptacle and prevent the members from bulging at their intermediate portions, one end of each of the bars being firmly mounted on the bottom of the receptacle.

926,654. ELECTRICAL IGNITION APPARATUS. Theodore Hubert, New York, N. Y., assignor to Charles F. Splitdorf, New York, N. Y. Filed January 25, 1908. Has a number of induction coils with a vibrator provided with windings having corresponding terminals connected together, the terminals being connected to opposite sides of the circuit of the primaries of the induction coils, and a condenser connected with opposite terminals of the windings.

926,663. TELEGRAPH-REPEATER. Edelmiro Longoria, Monterey, Mexico. Filed February 5, 1909. A repeater for each of a number of transmitters has a local circuit which is opened and closed by the corresponding transmitter, and



926,584.—ELECTRICAL SWITCH.

means operated by the one repeater are provided for retaining the circuit of the other repeater closed during the operation of the first repeater.

926,669. INCUBATOR-ALARM. Perry S. Martin, Broadway, Va. Filed February 17, 1909. Has an electric alarm connected to the damper-controlling mechanism.

926,680. DEVICE FOR MAKING AN ELECTRICAL CIRCUIT OR CIRCUITS. Walter S. Ryan, Indianapolis, Ind., assignor to Ryan Construction Company, Muncie, Ind. Filed March 4, 1907. Describes a form of electric switch with electro-responsive devices to be energized by the current flowing through the terminals and the contact points in the switch bar nearest its fulcrum, to oscillate the switch bar at each operation thereof.

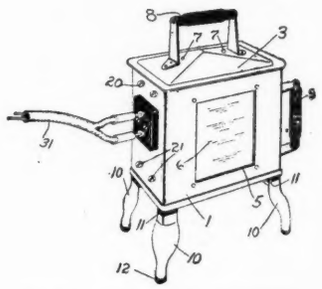
926,681. CIRCUIT-CONTROLLING SWITCH. Walter S. Ryan, Indianapolis, Ind., assignor to Ryan Construction Company, Muncie, Ind. Filed December 2, 1907. A movable member normally rests on a float in a receptacle and depresses the same, an electro-responsive device moves this member to release the float, and a contrivance controlled by the float energizes the electro-responsive device when the float is depressed and de-energizes it when the float is released.

926,682. SIGN-DISPLAYING DEVICE. Walter S. Ryan, Muncie, Ind., assignor to Ryan Construction Company, Muncie, Ind. Filed September 11, 1908. Describes a form of rotary display sign illuminated by a "linolite" lamp.

926,687. ELECTRIC-RAILWAY SIGNAL SYSTEM. Yorke Burgess, Washington, D. C., assignor to American Signaling Company. Filed November 5, 1908. Describes the details of an electrically operated railway signal system.

926,698. ELECTRIC IGNITION DEVICE. Theodore Hubert, New York, N. Y., assignor to Charles F. Splitdorf, New York, N. Y. Original application filed April 4, 1906. Divided and this application filed November 23, 1906. In combination with a magneto having make-and-break contacts are means to operate the movable member thereof, and a contact for a separate circuit arranged to be made and broken by the action of the movable member of the magneto contacts.

926,710. BIFUNCTIONAL STORAGE-BATTERY PLATE. Alfred O. Tate, Toronto, Ontario, Canada. Filed February 18, 1909. The plate embraces interleaved anode and cathode strips with perforated mechanical separators between them, and means are provided for holding the separators apart so as to afford a free circulation of the electrolyte.



926,714.—ELECTRIC TOASTER.

926,714. ELECTRIC TOASTER. Harold E. Bradley, Apponaug, R. I. Filed February 25, 1909. The bread rack is formed of rows of bars spaced apart and secured at their ends to plates of electrically insulating material, and an electric resistance wire is wound lengthwise around the rack whereby the contents of the same may be heated on opposite sides.

PATENTS THAT HAVE EXPIRED.

Following is a list of electrical patents (issued by the United States Patent Office) that expired July 5, 1909:

478,097. ELECTRIC MEASURING INSTRUMENT. Sydney Evershed, London, England.

478,139. ELECTRIC LOCOMOTIVE. Elmer A. Sperry, Chicago, Ill.

478,142. DYNAMO-ELECTRIC MACHINE OR MOTOR. Elmer A. Sperry, Chicago, Ill.

478,145. ELECTRIC ARC LAMP. Elihu Thompson, Lynn, Mass.

478,149. INCANDESCENT ELECTRIC LAMP-SOCKET. Henry E. Werline, Lancaster, Pa.

478,155. ELECTRIC ALARM-CLOCK. George C. Darche, Chicago, Ill.

478,175. ELECTRIC RAILWAY CONDUIT. Milton Shoemaker, Sioux City, Iowa.

478,180. TIME-SWITCH FOR ELECTRIC CIRCUITS. Benjamin E. Waters, Brockton, Mass.

478,182. ELECTRICAL DISTRIBUTION FOR CARS. Samuel Young, Morris Moskowitz, Leon D. Adler, and Joseph Loewenberg, Newark, N. J.

478,186. ELECTRIC LIGHTING SYSTEM. Edward T. Cooke, and William H. Mackay, St. Louis, Mo.

478,201. ELECTRICAL BRAZING DEVICE. Willis Mitchell, Malden, Mass.

478,230. SECONDARY BATTERY. James H. Gerry, Brooklyn, N. Y., and Charles E. Long, New York, N. Y.

478,242. ELECTRIC LOCOMOTIVE. Sidney H. Short, Cleveland, Ohio.

478,274. ELECTRIC INDICATOR. William E. Decrow, Boston, Mass.

478,276. RHEOSTAT. Winslow P. Eayrs, Nashua, N. H.

478,324. INDICATOR FOR ELECTRICAL SIGNALING SYSTEMS. Charles F. Gillette, New York, N. Y.

478,344. SYSTEM OF ELECTRICAL DISTRIBUTION. Harry W. Leonard, New York, N. Y.

478,346. ELECTRIC RAILWAY. Frank Mansfield, New York, N. Y.

478,367. ELECTRIC CABLE. William H. Sawyer, Providence, R. I.

478,475. ELECTRIC MOTOR. Jerome B. Secor, Bridgeport, Conn.

478,477. ELECTRIC LOCOMOTIVE. Sidney H. Short, Cleveland, Ohio.

478,485. ELECTRIC BATTERY. Charles F. Waldron, Boston, Mass.

478,510. ELECTRIC ARC LAMP. Rudolph M. Hunter, Philadelphia, Pa.

478,529. DYNAMO-ELECTRIC MACHINE. Charles W. Thomas, Jersey City, N. J.